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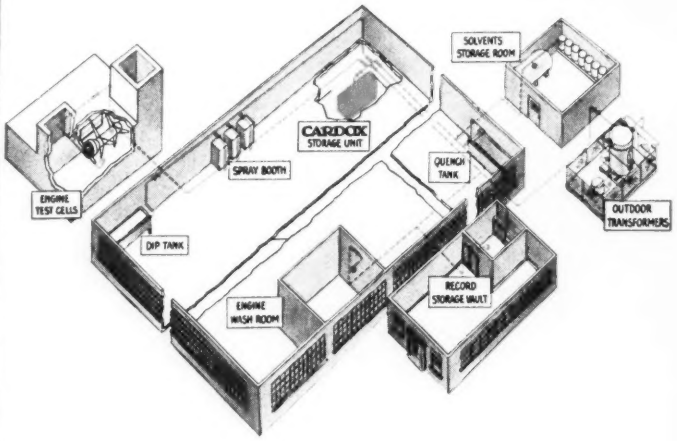
Quarterly

of the

National Fire Protection Association

INTERNATIONAL

Promoting the Science and Improving the Methods of Fire Prevention and Protection Since 1896



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Vol. 48 No. 4 April, 1955

Quarterly

The Standard Technical Journal of Fire Protection for More Than Forty Years

The NFPA is a non-profit technical and educational organization devoted to the reduction of loss of life and property by fire with a total membership of over 15,000. The *Quarterly* is one of the publications regularly provided to members. Other membership publications include *Fire News, Advance Reports* to the Annual Meeting, a *Year Book,* and many leaflets, pamphlets and posters issued throughout the year on fire prevention and control. Six volumes of the National Fire Codes are available on an annual subscription basis, one volume free and others at reduced membership rates. For full details on available material ask for the free "List of NFPA Publications."

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International
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Accounts of fires appearing in the Quarterly are based on reports forwarded to the Association except where otherwise indicated. The Association, as a body, does not assume responsibility for the accuracy of the fire reports printed herein.

This publication is indexed by Engineering Index, Inc.

Associated Press Wirephoto

This trailer truck carrying a load of bananas exploded in Middleburg, New York about 2 A.M. on April 9, just after the driver opened the doors of the trailer. From reports presently available the blast resulted from ignition of escaping gas from an improperly installed propane fueled heater in the insulated aluminum trailer. The heater flame had gone out prior to the driver's attempted entry into the trailer. The blast severely injured the driver but no fire ensued. The NFPA Committee on Truck Transportation is offering recommendations on the safe installation and operation of truck cargo heaters at the 1955 NFPA Annual Meeting for incorporation in NFPA No. 512 and the NFPA Standards for the Storage and Handling of Liquefied Petroleum Gases (No. 58) were revised in 1954 to incorporate more adequate rules covering "Cylinder Systems for Cooking and Heating Installations on Highway Mobile Vehicles."

Wartime Fire Fighting

By Horatio Bond, Chief Engineer
National Fire Protection Association

This article is about wartime fire fighting by public fire departments. It will draw on the experience of fire departments which actually worked under bombings of World War II. From these experiences we will make the best guesses we can as to conditions produced by the modern A- and H-bomb weapons.

We have been living, since World War II, in an atmosphere which, in some ways, is a little hard to explain. Many of the lessons of the last war and of the A-bombs and H-bombs are perfectly plain. They pose to everyone some very serious problems. Solution of many of these problems means radical change in how we build our cities and how we run our fire departments. Rather than face the necessity for making any of the obvious changes, most citizens and officials of government, federal, state and local, have preferred to ignore the problems of modern war.

Some problems, if ignored long enough, will go away. I wish the same could be said of these.

Much information on the fire department experience of World War II has been published. However, it has had limited circulation, reaching only a few of the more alert individuals concerned. In 1952, I wrote a little 84-page book entitled "A 'First Book' on Fire Safety in the Atomic Age," which was based on a paper prepared for a symposium on "Building in the Atomic Age" at the Massachusetts Institute of Technology. This was published by the National Fire Protection Association in a small edition and some of you may be able to find copies for reference. It contains a bibliography for most of the published references to wartime fires and fire fighting.

English Experience

The experience of fire departments in England was reported on in the book "Fire and the Air War" (276 pages, 1946), also published by the National Fire Protection Association. English cities were never hit as heavily by bombing as Japanese and German cities but the English fire departments learned important lessons of organization. The fire departments found that "mutual aid" arrangements would not work in even relatively light bombing attacks. They found that they had only a handful of fire department officers who had the slightest experience in handling the large forces of firemen and apparatus which are needed to deal with fires over an entire city. This is understandable because, in peacetime, fires come one at a time. A fire officer seldom has to direct the activities of more than a few pumpers and ladder trucks.

The British experience in fire department organization is more applicable than the German or Japanese to the situation in the United States and Canada. The problem is partly a political one. In the United States relationships between fire departments and the city and state are similar to those in the Unit-

ed Kingdom. The British experience forms the basis for a discussion of "Requirements of Fire Department Organization for Major Disaster Work" in the text "Municipal Fire Administration" (Fifth Edition, 1950) published by the International City Managers' Association. This is one important available reference.

In addition, there is a book, perhaps out of print, entitled "The Auxiliary Fire Service and Its Organization" (316 pages, 1940) by Harold Bevir, published by the National Fire Brigades Association, London. This recounts the thinking of English fire department people up to the period just before the blitz. After the blitz, the fire services were centralized under that part of the English government which corresponds to a state government in the United States or a province in Canada, namely, the British Home Office. Following the war, Home Office supervision was continued, although the fire department units were subdivided into 135 separate fire departments. Pre-war there had been 1,400. British postwar fire departments are practically all big departments, with a good headquarters fire staff and enough experienced chief officers to operate as a going organization in another war. A similar result could be accomplished in the U. S. if the fire departments were combined into large county or regional groups within each state with a state headquarters staff. It would mean a shift, however, from municipal to state control of fire departments.

A German City Center. The usual result of a World War II air raid was the burnout of the central business district of a German city. Small incendiaries set fire to every building. They even entered the windows of fire-resistive buildings like the department store in the picture. This is Stuttgart. Most of the damage was done in September 1944. The picture is one made in May 1945 when the fire-resistive building had been restored to some measure of use by bricking up windows.

Business Street in Osaka. Some Japanese buildings had masonry fronts like the one in the foreground of this picture but this view illustrates the usual low height of buildings and the wood frame construction of most of them.

Japanese Experience

The heavier attacks on German and Japanese cities are probably more representative of the types of situations which fire departments will face in another conflict. If the A-bomb and H-bomb had never been invented, we would still be discussing great fires as a wartime problem. Before the A-bomb, the Royal Air Forces of the British Commonwealth had destroyed at least 54 German cities and the U. S. Army Air Force had destroyed 65 Japanese cities. The fact of fire as a weapon of war had been established and the ruins of the cities are there to prove it. To visualize the typical destruction in these cities, take any city with which you are familiar and assume that approximately half of the city's buildings are completely destroyed and that the downtown section is practically wiped out. Of the damage, 75 to 80 percent is fire damage and not merely destruction by blast of explosive bombs.

The Japanese fire experience is quite completely covered in the book "Fire and the Air War." It has a good chapter on the Japanese fire departments, describing their philosophy, equipment and methods. This was prepared by Commander Orville J. Emory, USNR, who was a member of the U. S. Strategic Bombing Survey.

Japanese cities were cities of wood buildings and great conflagrations resulted there from thousands of fires started by small individual incendiary bombs. The fires which occurred were of the same general sort as the conflagration in Atlanta, in May 1917. This destroyed 1,938 buildings. Numerous American cities have had similar conflagrations. In many of these, as in Atlanta, fire spread from building to building due to wooden construction and particularly due to sparks on wooden shingle roofs. Flying brands from the buildings which first ignited, showered other parts of the city, act-

ing just like the small incendiaries of World War II.

None of the Japanese cities had fire departments adequate for fighting these great fires. There was one case involving the City of Hachioji which showed that even large fire department forces could be overwhelmed. Hachioji was warned by U. S. air forces of the attack. This was customary at that stage of the war. As a result of the warning, fifty 500-gallon-per-minute pumpers and 300 professional firemen were sent to assist local forces. These provided, together, a total of 75 fire trucks or an average of 54 pumpers per square mile. In spite of this fire department force, 80 percent of the city was burned by the attack.

This experience does not mean that fire companies were never effective. It merely shows that large fire forces are not, in themselves, the answer. Large fire forces are simply subject to large losses of men and equipment in an attack. However, in Japan, the customary low wooden buildings made fire fighting possible in many cases. Fire companies were frequently able to limit the spread of an area fire by harassing it along the flanks. In other words, there were situations where effective fire crews were very useful.

Buildings in German Cities

While the majority of buildings in Japanese cities were 1½-story, flimsy wooden construction, there were, of course, some buildings more substantially built. Some buildings of fire-resistive types were pretty good. They were built to resist earthquake shocks, in some cases. There were also a fair number of buildings of ordinary brick construction. In these, the outside walls were brick but the interior bearing walls and partitions were of wood and floors and roofs were of wood joists.

By comparison, the type of construction in German cities was far superior. The typical building in a German city would be of relatively small area and seldom over 5 or 6 stories high. Outside walls were solid brick, thicker than in American or Japanese practice. Interior bearing walls and partitions were usually masonry. Partitions between rooms were frequently 4-inch brick, plastered on both sides. Wood was commonly used for floor joists and roof framing but it was customary to use somewhat heavier joists than used in the United States and Canada for similar buildings.

In the case of floors in joisted buildings, it would be common practice in the United States and Canada to finish the underside of the joists with a plaster ceiling and there would be a double wood floor above. In many German buildings, the construction would be the same but with the addition of a layer of inert material, like cinders, known as "pugging," about half way between the ceiling and the floor finish. This produced floors which had a considerable degree of fire resistance. They would, of course, burn because the total weight of wood in these floor assemblies was considerable but they were much slower to burn through than joisted floors

←

Japanese City Conflagration. Japanese cities were made up of predominantly wood buildings and so the usual picture after World War II fires was a burned-out plain like this one at Kobe. The few brick-walled and fire-resistive buildings usually burned out inside.

with which U. S. and Canadian fire departments are familiar.

The most common defect in German building construction was to have an open attic above a row of buildings and this permitted some fires to be needlessly extensive. This defect in German building practice had been recognized but it persisted in some of the older west German cities.

In Berlin, a relatively new city, most buildings along city streets had fire walls between individual buildings. These fire walls extended above the roofs, with parapets, so that a fire in one building was effectively cut off from spreading to the next. Berlin was relatively hard to burn. However, so many small incendiaries dropped that enough landed between fire walls to set each individual building on fire.

In a German city, it was not possible to have a conflagration in the sense that one occurred in Atlanta in 1917 or like the type of fire which spread from building to building in the Japanese cities. Nevertheless, great fires were set in the German cities. These followed a pattern which is relatively new, because never before had a large number of buildings been set on fire at the same time. The incendiary attacks started thousands of fires, each of which was burning on the same timetable. These fires joined to produce a huge volume of rising air which set up the kind of air movements which we associate with a tornado. In such a fire storm, once established, there is no possibility of fighting fires except at the fringes.

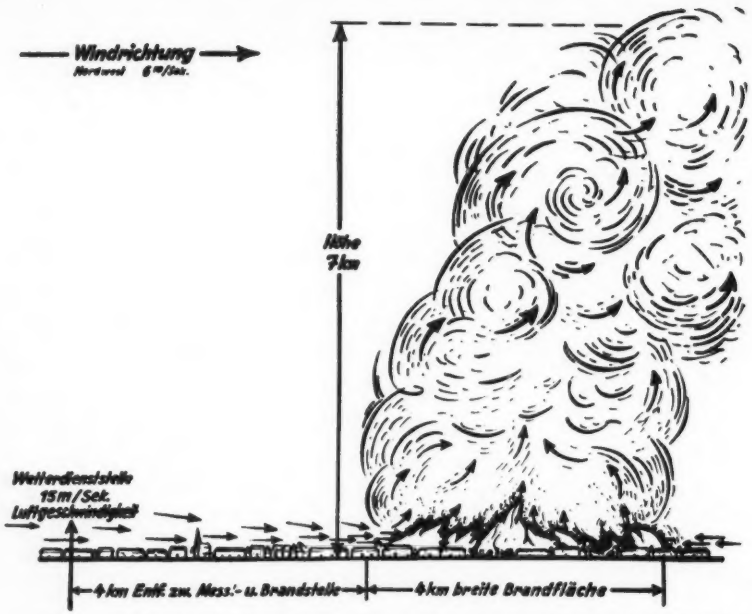
Photo courtesy H. Brunswig

Central City Area, Hamburg. This gives a good idea of the substantial brick walls in German buildings and their usual height and bulk. This particular group of buildings was less well-subdivided with brick fire walls than in other areas of German cities. The damage here was mostly in the first heavy incendiary attack the night of July 24, 1943. A fire storm did not develop in this attack.

Technical Observations in Germany

What I have to report on the German cities is, in part, firsthand personal observation of these cities immediately following the war. I was one of a number of American fire engineers who participated in the work of the United States Strategic Bombing Survey in 1945. Two distinguished American fire department officers also helped survey conditions in the German cities. They are Chief Fire Marshal A. J. Mullaney of the Chicago Fire Department and Frank C. McAuliffe, Chief of the Chicago Fire Insurance Patrols. We had an opportunity to jointly interview Doctor Engineer Colonel William Schlieman, who was second in command and the executive officer of the Hamburg Fire Department. He had prepared a statement summarizing his experiences in the air raids on Hamburg, July 24 through August 3, 1943, and his paper is one of those from which I will quote here.

The experiences of German fire department officers form some of the best information we have on which to base our decisions with respect to plans for wartime fire fighting. It was quite usual for a German fire department officer to be an engineering school graduate. In any case, the officers of German professional fire departments were well educated and many had received systematic training of very broad character. The top officer of a big



Wind and Smoke of Hamburg Fire Storm. This is a diagram furnished by Chief Brunswig describing some of the observed dimensions of the fire storm caused by the attack of the night of July 27 and the morning of July 28, 1943. The normal wind direction was shown as northwest, 6 meters per second or about 13 miles per hour. The height of the smoke cloud was 7 kilometers, over 4 miles. From the edge of the fire area it was 4 kilometers, or about 2½ miles, to a weather station at which wind velocities of 15 meters per second, or nearly 34 miles per hour, were observed. The fire area is shown 4 kilometers (2½ miles) wide.

German fire department would not only be a graduate engineer but, before being appointed Chief Officer, he would be expected to have served in all of the technical branches of the fire department. He would have served, for example, as chief of the fire prevention bureau and municipal building inspector. Building inspection, in German cities, was handled by the fire departments. He would also have been in charge of the fire department shops, to have a full experience with fire department equipment and buildings. He would have served as the department's training officer and also a tour of duty as chief of the fireboat or marine division of the department.

Officers with this kind of background have contributed important bits and pieces of information which are available to us. All the important German cities were hit by bombs. No fire departments in history ever fought more fires or bigger ones than the German fire departments. So the observations and opinions of German fire chiefs have particular validity.

Some of you may have seen some of the writings of Hans Brunswig, a chief officer (Oberbrandrat) of the Hamburg,

Germany, Fire Department. He prepared a paper entitled, "Area Fires and Fire Storms (Fläckenbränd und Feuersturme)," for a meeting of European fire department officials. It was published by the German Fire Protection Association (Vereinigung zur Förderung des Deutschen Brandschutzes e.V.) in its quarterly magazine, "Research and Methods in Fire Protection (VFDB-Zeitschrift für Forschung und Technik im Brandschutz)," June 1952 issue (Vol. I, No. 1).

This article by Chief Brunswig is an excellent statement of fire department problems and has some fine illustrations. I exchanged a number of letters with Chief Brunswig about this article and from this correspondence have detailed information on a number of points.

Another writer is the German fire engineer, Hans Rumpf. As a chief fire officer of the East Prussian City of Königsberg, he wrote, in 1931, a book, "Fire Bombs (Brandbomben)." While this spelled out the role of fire in the destruction of cities in a future war, there is no evidence that any important person in the British or U. S. air forces knew about it. I will not try to explain the know-it-all attitude of flyers, but you may be interested in what a German fire officer in Stuttgart said about them. I had asked him if he knew of any case where German air force people had asked advice from their very competent fire department technicians about incendiary bombing of English cities. He observed that the "boys that fly" are "very clever" and that it would not occur to them to ask advice from anyone as unimportant as a fireman. It was not surprising, therefore, to learn from Chief Rumpf that his book was not only ignored in Germany but was suppressed.

However, Chief Rumpf appears to have had considerable personal prestige. He served as General-Inspector in charge of the government mobile fire department forces (Generalmajor der Feuerschutzpolizei) during the war. I have, through his courtesy, a reprint of a chapter he wrote entitled "The Air War Over Germany (Luftkrieg über Deutschland)" for a book entitled "The Pros and Cons of World War II (Bilanz des Zweiten Weltkrieges)." This book presents the German point of view about the war by a group of distinguished Germans. It was published in 1953 by Gerhard Stalling at Oldenburg, Germany. It is significant that a fire chief rather than a military man was asked to prepare the chapter in this book which dealt with the air war. It indicates that in Germany, at least, it is understood that fire damage is the principal damage caused by the air war.

He points out in this monograph that the damage by the war to Germany is so tremendous that a complete inventory has not yet been made. He says damage is known to have occurred in 1,042 cities of over 3,000 inhabitants. Nearly all of these were damaged: in 62 of them more than 50 percent of the built-up area was destroyed. The losses were heaviest in such cities as Berlin, Hamburg, Cologne, Dortmund, Munich, Essen, Frankfurt, Nürnburg, Düsseldorf, Hannover, Duisburg and Bremen.

Fire Storm in Leipzig

Another book by Chief Rumpf is of more direct interest to fire department people. This is entitled "The Bright Red Rooster (Der Hochrote Hahn)" published in 1952 by E. S. Mittler & Sohn,

Schofferstrasse 15, Darmstadt, Germany. In continental Europe, the red rooster is the symbol of fire and incendiarism.

This latter book by Chief Rumpf contains numerous descriptions of situations which have significant points of interest to practical fire fighters. This and certain other documents mentioned are in German but, for anyone with a working knowledge of that language, they are rewarding reading.

In "The Bright Red Rooster," Chief Rumpf contributes a particularly fine bit of writing describing a great fire in the German city of Leipzig, population about 700,000. In this fire, the fire storm phenomenon appeared. He described how the British Royal Air Forces hit the city in a concentrated 25-minute attack, principally with fire bombs of the four-pound magnesium-stick variety and a few high explosive bombs. The result, he said, was that the attack area in the Inner City was totally destroyed with 2,700 dead and 125,000 homeless. In two hours the old Inner City was completely ablaze, with flames reaching into the sky like a gigantic torch. Here is a translated extract of what Chief Rumpf further says about this Leipzig fire.

"Such a species of natural phenomenon as this can alter the properties of the atmosphere so that organic life is no longer possible therein and ceases. We have become accustomed to calling this phenomenon a 'fire storm.' The single fires join, the heated air shoots upward as if in a giant chimney. The fresh air, sucked and rushing along the ground, creates a hurricane which in its turn fans the smaller fires and draws them into its course. The effects of such a hot column of air from a giant torch over a burning city were felt by flyers up to 13,000 feet in the air

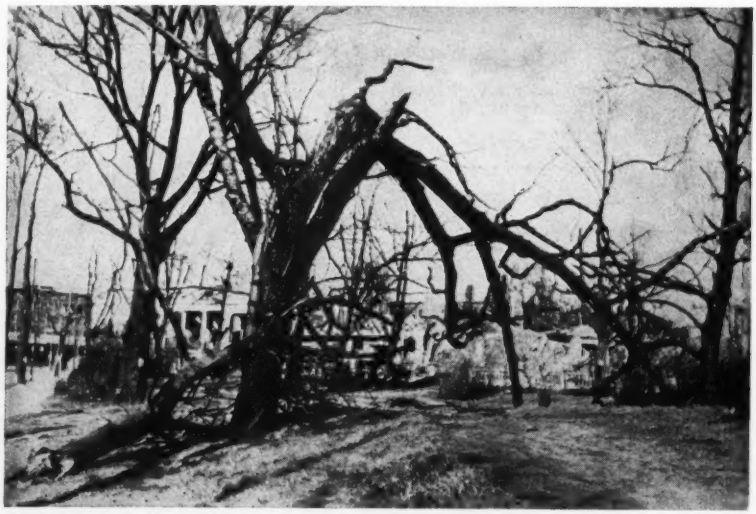


Photo courtesy H. Brunswig

Typical Tree Damage. Tree damage of the kind typical in hurricanes is evidence of the force of fire-storm winds. These trees were near Hamburg fire department headquarters.

and described as stormy and unpleasant. The only possible comparison is with the storms of the tropics at the peak of the wind scale. Our latitudes do not know the strength and devastating effects of such hurricanes.

"Whoever has not, himself, experienced a fire storm will find it difficult to get a true picture from a description. At its edge are the conditions of a heavy storm. The roofs of trucks fly off, people's coats are pulled over their heads, those not standing firmly are knocked down. Approximately two and one-half miles from the edge of such a fire, a weather station has measured a wind velocity of 34 miles per hour which increased rapidly as one neared the fire area.

"At irregular intervals squalls arise which strengthen the impetus of the storm. There is swirling, splintering and crackling everywhere, even from the buildings and street fronts spared by the fire. The resistance of the building sections, calculated up to 30 pounds per square foot, no longer suffices, a sign that a storm velocity of 75 miles per hour has been exceeded.

"Further in, life is practically impossible outside of protected buildings. Strong trees fall to the earth with splintering trunks, young trees are pressed to the earth like twigs. Hamburg lost 70,000 of its 100,000 street trees in this manner.

"Motion is possible only by crawling and even that is difficult and dangerous. I remember how firemen trying to arise were thrown down and whirled away until they finally were left lying with broken limbs in some sheltered spot. We had terrible casualties. Again and again men were actually hurled into the air. The driver of a fire truck was lifted out of his vehicle and thrown to the pavement before my eyes. He died of a fractured skull that same night. We tried to send an automobile sedan across an open square from the protection of a garage. It was seized by the wind and, tumbling over and over like a box, was carried off with its occupants. The basement of our fire station was like a dressing station for troops in the front lines.

"The air outside seemed to glow as the wind whipped cascades of sparks and glowing clouds of ashes through the streets. The yellow-red gleam distorted all contours and turned our faces into masks. Billow after billow of fire roared and howled toward us. Through this red glow the gusts tore away all kinds of objects as if all force of gravity was suspended.

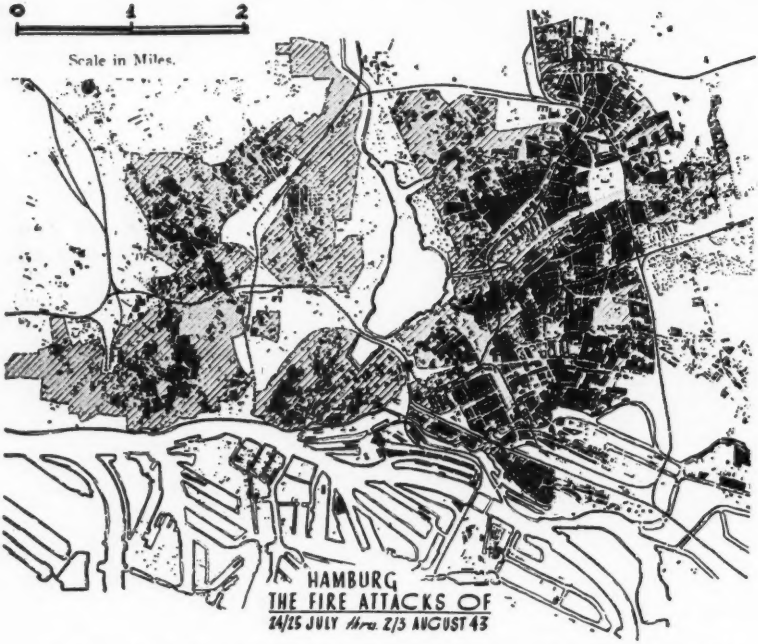
"Burning beams, rafters, window frames and other building elements sailed through the bright stream of sparks. Once I thought I saw a flaming motorcycle fly past, just above me, but that was probably an optical illusion. Everything was gigantic, powerful, unique, incomparable. We were impressed and fascinated, in a completely unexpected manner, by the size and power of these fiery forces of nature which we had first approached with very sober professional thoughts and plans."

The Hamburg Attacks

In another part of the book Chief Rumpf discusses the attacks on the City of Hamburg. The following are extracts:

"In the summer of 1943, British night attacks were the rule. American daylight raids were still the exception. . . . The attacks on Hamburg fell off in frequency and intensity. . . . There were unaccustomed lulls of up to ten days and nights. We didn't know the reason but we had evil forebodings. We were soon to find out: it was the windup for a new destructive blow of an unprecedented magnitude, a preparation for attacks of a new style, utilizing the results of all the secret experiments with radar. The era of 'obliteration bombings' had arrived.

"The first blow of this kind struck Hamburg. It was rather a series of blows which descended upon the city in the hot summer days from 25 July to 3 August 1943. In those nine days, the city was hit five times at night and three times by day, by a total of 3,000 heavy bombers. In the first daylight hours of July 25, the first wave of 800 bombers . . . made a concerted incendiary attack with magnesium stick fire bombs and oil-phosphorus bombs, against sections of the Inner City and the harbor. The total of 1,500 dead and the countless numbers of fires were very high, in comparison with earlier attacks.



Hamburg's Fire Damage. North is at the top of this diagram prepared from aerial photos and checked on the ground by engineers of the U. S. Strategic Bombing Survey. Hamburg was a city of about 1,700,000 population. The light shading shows the substantially built-up areas of the city. The black areas are blocks and individual buildings completely burned out, and which were located all over the city. The first of the heavy attacks, the night of July 24, hit the western side of the city principally. There was some loss of life, perhaps 2,000. The attack the night of July 27 did the most damage and it was in this attack the fire storm occurred. This was in the St. Georg area, the lower half of black areas east of the Alster. Life loss was heavy, perhaps 60,000 to 100,000, although lower figures have been used by German officials since the war. The third heavy attack, the night of July 29, burned another great area on the east and to the north. Life loss was less, perhaps 800, because many had evacuated.

"The following attacks, until the 27th, were more endurable harassing raids. On the night of 27-28 July, a new attack of about 800 heavy bombers created a situation which showed all the preliminary calculations of the fire department and other divisions of the local air raid protection organization to be pitifully short of reality. Within half an hour, a dense hail of fire bombs turned another large sector of the city into a sea of flames."

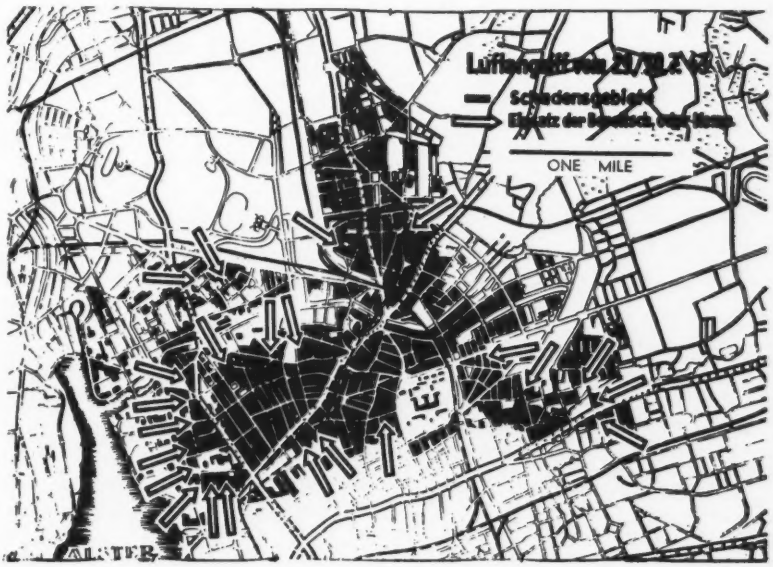
The raid of which Chief Rumpf is here speaking is one in which a fire storm developed. He continues:

"In the following night, the sixth, an even heavier attack caused the last organized defense effort to collapse. . . . The Chicago and San Francisco fires and other great fires which have been reported by contemporaries in terrifying, fantastic and horrifying images must pale before the size and uniqueness of this Hamburg fire. . . There were 250,000 dwell-

ing units completely destroyed out of 556,000 . . . 40,000 people had lost their lives. . . .

"Moscow had burned five days in 1812, the old city section of Hamburg four days in 1842, San Francisco three days in 1906. Now the cities were being totally enveloped with fire and burned to the ground in a matter of hours. The only things remaining were broad fields of rubble, hollow buildings, empty facades of deserted streets of a ghost town—lifeless illusory settlements. The burnt city lay like a waste land, full of bricks, rubble, dust and old iron. Over an expanse of several square miles lay the crushed and charred ruins and only here and there could be seen, still standing, a five-story building or a single house block. Up to this time, only the blind fury of nature had been able to wreak such destruction.

"A description of the details of this inferno, the 20 suffocated persons draped over a bridge railing or the cluster of dead persons who had vainly sought shelter behind a telephone booth from the lethal heat, or the charred bodies of mothers with their children in their arms, or the corpses stripped stark naked from the bomb suction, is impossible. It cannot be expressed by all the power of words. Bodies shriveled like stumps to about three feet in length, black, with a very small head—these lay everywhere. Dead hung over balconies. Men huddled asphyxiated on the luggage with which they were fleeing. In the waterways between houses, a condition peculiar to parts of Hamburg, and in the canals were the bodies of persons who, afire, jumped in but found no deliverance there since there was phosphorus from the oil bombs on the sur-



Surrounding a Fire Area. A diagram furnished by Chief Brunswig to show how fire companies surround a fire area. The area mapped is that hit in the Hamburg attack the night of July 29, Uhlenhorst and Barmbeck-Nord. The area of concentrated fire is the black which indicates blocks and individual buildings destroyed in this attack. The area south was burned out in the fire storm two nights earlier. Each arrow shows where a fire company made its attack. European fire companies are roughly the equivalent of a battalion force in North American fire department practice. Each arrow should probably be considered to represent 15 or 16 vehicles, of which 6 would be pumpers and 3 would be aerial ladders, plus a force of about 100 men.

face of the water. As soon as they came to the surface their heads were burned. . . . Phenomena occurred which we had never known in this new form and effectiveness. That was particularly true of the all-conquering force of the fire storm whose hurricane power exceeded by many times anything yet known, or the bursting into flames of the softened asphalt street pavements in which many refugees met a miserable end. . . .

"Among the surprises of this raid was the almost complete failure of our aerial night fighters and anti-aircraft artillery. . . . The main burden of the defense of the city lay almost solely upon the weak shoulders of the police and auxiliary services and their passive protective measures. The efficiency and valor of the men in the Hamburg fire fighting forces were of no avail. This included 120 battalions on land, 36 on the water, a total of 3,600 officers, non-commissioned officers and ordinary firemen. . . . The losses multiplied. The automobile equipment of entire units was destroyed—blocked in the disintegrating streets —while the personnel often tried in vain to escape with their lives.

"The support by neighboring units that could be spared was generous and excellent as never before. . . . As the attacks progressed, strong fire fighting forces from central and eastern Germany were rushed to Hamburg. Berlin, Magdeburg, Hannover, Leipzig and others sent auxiliary forces, as Bremen, Keil, Lübeck, Wismar and Stralsund had already done. Outside forces soon exceeded the local ones. . . . The Hamburg fire department, taking advantage of the countless open water reservoirs in the outskirts, succeeded in bringing system into fire operations, setting up barricades, organizing coordinated operational fronts and driving wedges into the burning districts. But whole sections of the city were already burned down and formed gruesome landscapes of rubble as far as the eye could see."

Fire Fighting Counted

One reason for quoting extensively from Chief Rumpf's accounts of fire fighting at Leipzig and Hamburg is to give the background for an observation he makes. He is able to say that even though the fire forces were terribly overwhelmed, he felt that they performed useful service. He continues:

"Often the fire stopped only when it found no more fuel. . . . Even if the battle against the fire was hopeless in the center of the gigantic area fires, on their periphery and, in countless individual locations, gradually here and there, the fire fighting began to show results. Individual structures, house blocks, lines of streets and whole districts were saved. These would certainly have been destroyed if it were not for the efforts of the fire fighting forces. Thousands and tens of thousands of families here, and in the other cities, are today indebted to the fire departments for their homes—the safety of their saved dwellings. So, taken as a whole, the efforts, even in Hamburg, have not been completely in vain."

Fire Fighting Is Small Line Work

From the German authorities it appears clearly that wartime fire fighting is mostly small line work, the emphasis being on fighting fires in the interior of buildings. Little use of large streams and water curtains is made and long relays are seldom undertaken. This is contrary to one notion which is widely held.

Chief Brunswig says, for example, "It is wrong to assume that in the case of a fire in a city a 'fire front' will come rolling along, as in the case of forest fires, and that it can be stopped by erecting an obstacle in the form of a water curtain." In wartime, as well as at peacetime fires, he explains that fire fighters must work inside buildings and attack fires floor by floor. A war attack may set on fire a large area of the city. There will likely be a central area of buildings which will be completely involved in fire. It would be obviously useless to try to attack fires in such areas but, he says, "on the perimeter there are individual fires which can be fought in the usual way as separate fires."

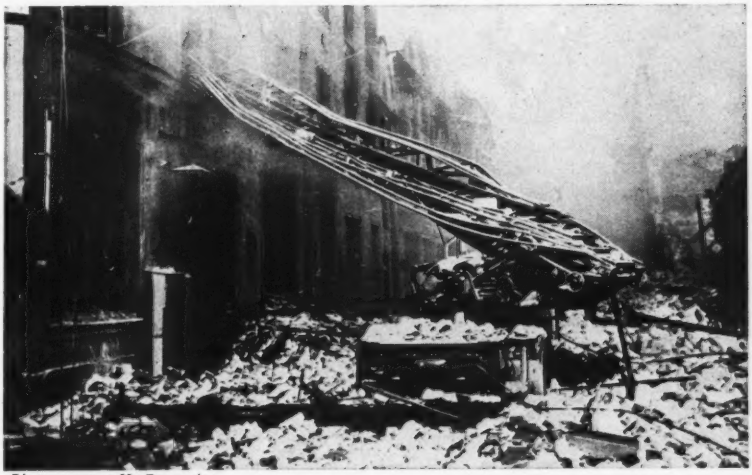


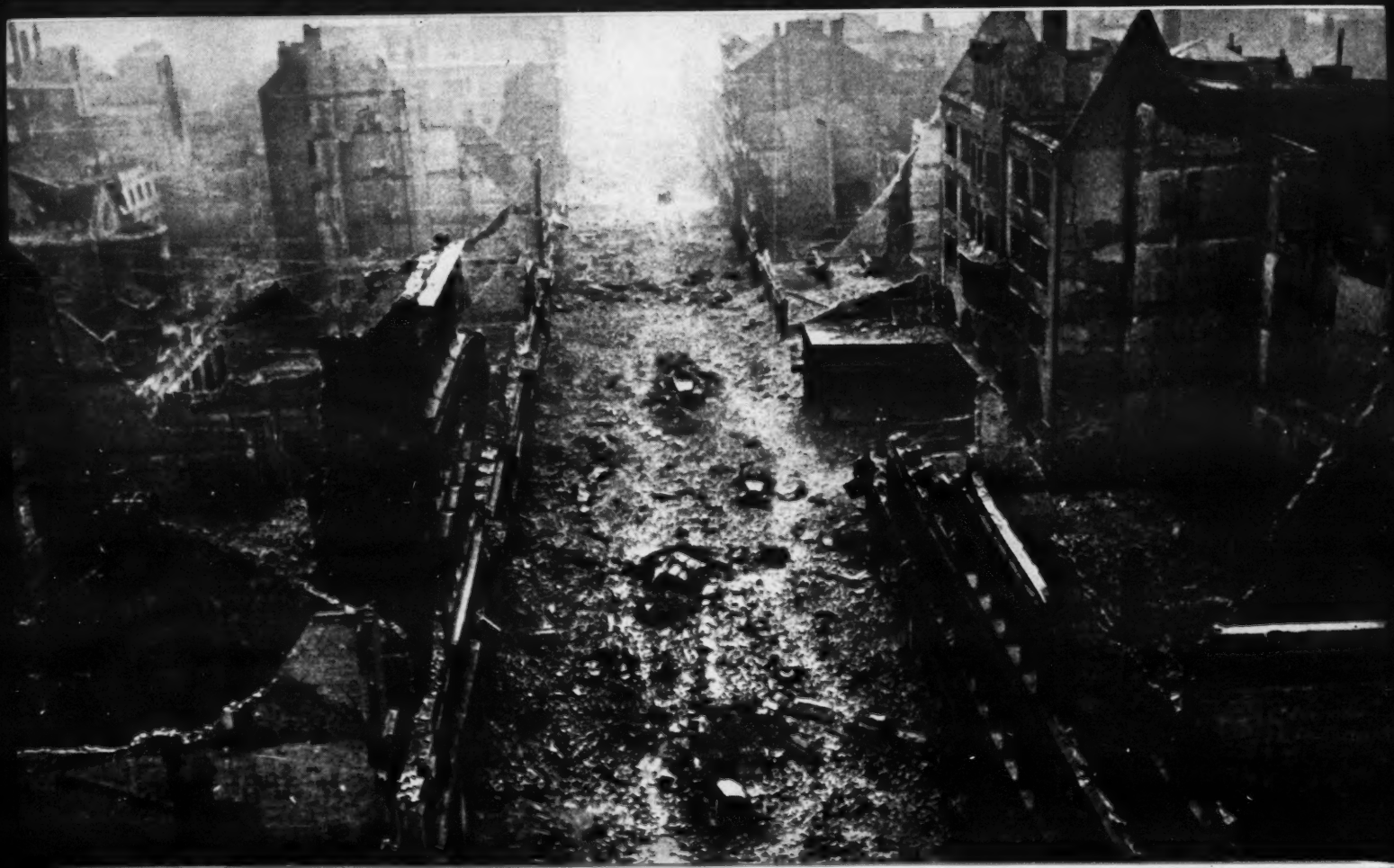
Photo courtesy H. Brunswig

Damage to Fire Apparatus. A turntable aerial ladder truck broken by the collapse of the wall of an entire building. One fireman was killed and two were severely injured in this incident.

As a first step in planning to fight wartime fires, it is necessary to get rid of any notion that fighting fire is a matter of setting up "water curtains" with large hose streams. The German fire departments tried them but found them impractical. Chief Schlieman observed that one trouble with the volunteer fire companies which came into the city to assist was that they did not understand the necessity for attacking fires in the interior of buildings.

Chief Brunswig points out that one large area of fire at Hamburg measured about eleven miles at its perimeter. If water did not have to be brought long distances, it could be surrounded by about 130 pumpers to the mile. If long relays were to be attempted, the number of pumpers per mile would have to be multiplied a number of times. Chief Brunswig observes that a war minister would be frightened out of his wits by even contemplating equipment and manpower for fire fighting on any scale such as this, because the military tend to regard civil defense as a subordinate secondary phase of national defense.

The figures Chief Brunswig uses for the encirclement of a fire area are an admittedly thin distribution of defensive forces, much too thin for much heavy-stream fire fighting operations. Chief Rumpf mentions some figures for the situation he observed at Leipzig which even more emphatically support the fact that fire fighting has to be small line work. There, he reports, for each piece of professional fire apparatus there were simultaneously 90 fires burning. The officer in charge of firemen on a piece of apparatus had to decide which one fire he would attack and which of 89 others he would leave burning. This means that no crew can stay very long in one spot as it must knock down one fire and get



on to the next. It is simply not appropriate to get large hose lines fixed in place for a long drawn-out battle at any one building.

During, and immediately following an attack, the mopping up of fires once they are knocked down by the professional fire fighters is the work of fire-guard teams and the householders. Long after the attack there is still fire fighting to do. Chief Schlieman points out that for quite a long period after the July 1943 fires in Hamburg it was necessary to keep the scenes of fire under close supervision in order to extinguish fires that rekindled. He said that this was a serious factor for a period of a month after the July fires and, in individual cases, they had rekindles as late as the beginning of October.

A Three-Hour Time Factor

In a great city fire, it is necessary to bring all the fire forces which are to be effective into operation within about three hours. Chief Brunswig points out that this has been true of all the great city fires of history, as well as the wartime ones. Chief Schlieman reminds us that the development of the fire areas and any resulting fire storm takes place in an extraordinarily short time. The fire storm at Hamburg was established about twenty minutes after the dropping of the first bombs. The fire had run its course in about three hours, after which it began to die down.

This time scale is very important in deciding whether or not the arrangements for mobilizing fire crews are such that it is worth mobilizing the crews at all. Both Chief Schlieman and Chief Brunswig mention that at the largest area fires in Hamburg, a force of some 1,400 pumpers was at work. Some of these had to come long distances, up to 250 miles, from Leipzig and Dresden, for example. A good many of them did not arrive within the three-hour limit referred to. The issue of readiness orders to units outside the city, the briefing of officers assigned to lead the reinforcing companies, and their departure from assembly stations to the scene of action are matters that cannot be quickly handled and which usually take hours.

Chief Brunswig points out that civilian air defense cannot be a voluntary operation. In several places, in what he has written, he stresses the need for an organization that can move effectively within the time limits presented by the great fires.

Reconnaissance and Communications

Wartime fire fighting requires reconnaissance to an extent not common in peacetime fire fighting and there must be a communication system which will work under conditions of an air attack.

Looking back at big fires over the last hundred years, Chief Brunswig notes that:

"The fire fighting forces were scattered in individual actions. A comprehensive plan for action against the fire was impossible be-

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Photo courtesy H. Brunswig

Trapped Fire Forces. Fire apparatus cannot be dispatched in the ordinary way to war-time fires involving large sections of a city. This picture shows what happened to a fire fighting company of 12 vehicles which was first trapped and then burned in debris. As the fires developed this street became a flue filled with flames and flying brands. This picture was taken in Steindamm, a main thoroughfare of Hamburg.

Photo courtesy H. Brunswig

Wrecked Reconnaissance Car. This picture illustrates the difficulties of fire officers' cars reconnoitering a fire situation. The front axle of this car became entangled in wires of the electric trolley system. The wires tore off the front wheel but thereby prevented the car from going into a crater made by an explosive bomb. Note that the headlights of this car are blacked out. Reconnaissance operations have to be carried on sometimes in pitch darkness but almost always in smoky, dark conditions.

cause there was no exact survey of the fire area's actual extent and its chances of spreading.

"We have learned that reconnaissance of the area involved in the fire is of crucial importance if effective measures are to be carried out. Such attempts, however, are of value only if the reconnaissance can be completed within an hour. Experienced fire department engineers were immediately sent out from fire headquarters in Hamburg during the July 1943 attacks in the areas believed to be on fire. Their vehicles were soon caught in rubble; they were unable to get very far and often barely escaped with their lives. Incoming reports were both insufficient and too late (for example, it might take as much as an hour to go a mile in an automobile making a reconnaissance).

"Even in daylight, a survey is not possible because of the enormous amount of smoke. In the section of Hamburg set on fire during 27-28 July 1943, full daylight did not prevail again until thirty hours later, despite the fact that the sky was sunny and clear above the fire zone. A sufficiently quick and reliable reconnaissance can be made only with the aid of helicopters and radio. But the planes must carry fire department engineers who are familiar with the locality. Because of the unusually thick smoke and flames, the reports given by other observers did not provide an accurate appraisal."

Chief Brunswig's description of the difficulties in reconnaissance sounds an effective warning. Our planning for wartime fire fighting has not sufficiently taken into account the fact that fire fighting operations may have to be carried out in darkness. Even the light of the fires may not penetrate far through smoke and dust. If we visualize conditions immediately following an attack with A-bombs or H-bombs, it can be assumed with certainty that there will be blinding clouds of dust extending out for considerable distances from the center due simply to air movements

set up by the blast. It is not a comforting picture but realistic planning for fire fighting must take this factor into account. It is no place for novice fire fighters or an organization without command experience.

A further need is a communication system that will really work. Chief Schlieman pointed out that at Hamburg most of the telephones could not be used during the air raids. Orders for the units of the fire brigade could frequently be sent by motorcyclists only. It was very hard even on motorcycle to get through heaps of debris in the streets. Very often such messengers had to go considerably out of their way to reach their destination and they were happy if their tires were not punctured so they would not have to proceed on foot.

Getting information back to a central control station was equally difficult. Fire officers could not get reliable information about the situation, as men on observation posts throughout the city were prevented by the dense clouds of smoke from seeing anything.

In order to arrive at some system in fighting fires, Chief Schlieman says that the areas burning were split up in fire districts, an officer being given responsibility for a definite area. In this area, he commanded independently of the central control.

Chief Schlieman further reports that firemen from places other than Hamburg reported at assembly stations at the outskirts of the town. The central control station gave orders to which districts the units arriving should be directed. The best arrangement was when a group of outside companies could be assigned a definite fire district under their own commanders. This was pos-

Photo courtesy H. Brunswig

Another Wrecked Reconnaissance Car. This car plunged into a bomb crater filled with water while traveling in darkness. Of three men in the car, one was drowned.

sible when outside companies arrived in large forces with sufficient commanders to go to work. It was very difficult to use volunteer fire brigades which arrived in small units. These had to be formed with other units and they often did not have chief officers familiar with handling a number of individual fire companies.

Chief Schlieman points out that it was a great advantage that the Hamburg fire department had its own means of communication, quite independent from that of the public telephone system. Most of the fire department cables were underground. While they were in the same street ducts as telephone cables, the fire department communication circuit could be repaired by its own personnel in a very short time. That was possible because cables of the fire service consist of a few wires only. The repairing of telephone cables, consisting of hundreds of wires, took considerably longer.

In early raids on Hamburg, the communication system could always be repaired between raids. During the last raids, the communication system of the Hamburg fire department was the only one working.

Fire Department Vehicles

In his paper on area fires, Chief Brunswig observed:

"As a rule it is useless to send fire-fighting crews into the fire area. Their vehicles usually get stuck in the rubble near the outskirts of the area . . . Numerous attempts to force a lane through the ruined area by means of caterpillar-tracked vehicles (both half- and full-tracks failed after these had been driven a few feet. The idea of constructing a caterpillar-tracked vehicle (firestorm tank) for fire fighting purposes therefore had to be abandoned. Only by means of dirt-moving equipment of the largest size is it possible to prepare a lane for regular motorized fire trucks. If motorized fire trucks are to be used, they must be basically different."

In a letter Chief Brunswig develops his ideas on fire department vehicles in more detail:

"Travel by means of motor vehicles in rubble presents considerably greater difficulties than is normally assumed and can in no way be compared with running over open ground. We made many experiments with vehicles during the war and were unable to achieve any wholly satisfactory result.

"It seems to me essential that the choice be limited fundamentally to light vehicles, with a short wheel base and large ground clearance. The fire-fighting vehicles common in Germany, during the war and after, with wheel bases 160 to 200 inches, are all too long, have far too little ground clearance, and are far too heavy.

"A short time ago, in Denmark, I had an opportunity to inspect some fire-fighting vehicles of the Danish air raid protection organization which had been built on American fire truck chassis. These were vehicles of really enormous dimensions, with enclosed bodies. In spite of their good motor and chassis construction, they could not stand the test of operation in emergency in a rubble area. It must be added that part of the tool boxes in these bodies were too high so that they could not be reached by small men without a ladder. With such a body, the center of gravity of the vehicle is too high so there must always be a danger that the vehicle may tip over.

"For purposes of air raid protection, I have suggested that a squad of vehicles, whose specific purpose is to penetrate into rubble areas, be created to supplement normal fire apparatus. It is composed of:

"Squad wagon, with crew of four fire fighters and one messenger.

Photo courtesy H. Brunswig

Small Rubble Piles Present a Barrier. This photograph was taken in Lubeck showing the rubble which develops in streets from fires in brick-walled buildings only 2 to 3 stories in height. The street is passable for motor vehicles only up to the point from which the picture was taken. Very slight depths of rubble, as little as 20 inches, make a street impassable to ordinary automobile vehicles.

"Tank truck, the largest possible water tank and built-in or portable pump of about 210 gallons per minute capacity at 114 pounds, with crew of two fire fighters.

"Hose wagon, with crew of two fire fighters.

"These vehicles would be on German Mercedes-Benz-Unimog chassis. The squad wagon would be a personnel carrier only. The number of firemen suggested for each vehicle includes the driver.

"The number of firemen and this type of equipment appears to be small. According to our experience, however, it is less important to bring great crowds of auxiliary firemen and auxiliary equipment into the areas of damage than to have a few resolute and experienced men with good equipment. They can achieve decisive results and also contribute effectively by helping people still remaining in damaged areas and instructing and stimulating these people to help themselves.

"I can report the following pertinent experience of my own: it occurred at Hildesheim, near Hannover. After a heavy raid, the old city area was almost completely burned down, with accompanying phenomena like a fire storm. Also burned out was a post office building, in the basement of which were located the cable terminals of extraordinarily important long-distance cables. The burning of the cable terminals would have meant extremely serious disruption of the entire German communication network. However, a squad of six fire fighters, who were told of the importance of their job, succeeded, without major difficulties, in saving the basement area with a single 2-inch hose line. We know of countless other experiences in which, with very small forces, decisive results were likewise achieved. It was always necessary, however, to bring these forces right to the critical point with their equipment in spite of rubble-filled streets.

"In reflecting on these incidents, I believe that in future air raid defense planning, vehicles must be designed which are suitable for these needs. From what I know of European efforts in this field, the necessary conclusions have unfortunately still not been

drawn from the experience of World War II. In many countries trailer pumpers are being procured, as usual, in large numbers (400 in Holland recently, for example), in spite of the fact that it has been demonstrated absolutely that this sort of heavy apparatus, weighing a ton or more, cannot be brought by hand across rubble to points where suction may be taken. At the beginning of the war, the regular fire department of Hamburg had a rather large number of trailer pumpers which had done very well in peacetime. After the first heavy air raid, they were tacitly withdrawn from service without any particular regulations to that effect, because no further use could be made of them. Even the portable power pumps, with a rated capacity of 210 gallons per minute at 114 pounds per square inch, widely used in Germany, were too heavy in many cases. They could be brought to water only by the most exhausting effort on the part of personnel."

In his cited article, Chief Brunswig discussed another matter of interest to us, equipment for water relay. He said:

"The delivery of water over long distances was the subject of a special study in Germany during the war. From mathematical calculations on many proposals for solving this problem, it was concluded, 'only simplicity can succeed in an emergency.' The simplest and most reliable operating method was to relay water from pumper to pumper. Each pumper delivered water through hose or pipe to a tank from which the next pumper in the relay took suction . . . For the protection of hose lines against damage, especially at street crossings, not one of the many hose-bridge constructions proved completely satisfactory. The best solution was always to place the hose lines in a trench in the pavement."

Such a trench could readily be made in many German cities by simply prying up a row of cobblestones.

First-Aid Fire Fighting

In Hamburg, according to Chief Schlieman, the fire department count was fires extinguished in 2,427 buildings and the extension of fire to adjacent buildings was prevented in 635 cases. These figures, of course, are for fires with which fire department crews attempted to deal. In an attack with small incendiaries, thousands of fires are started and the principal fire fighting must be by those people who deal with the individual small fires before they get to a size where public fire service is required. Chief Brunswig estimated that first-aid fire fighting in Hamburg, quite apart from the fire department operations, saved about 20,000 houses, including those which had been hit by incendiary bombs or which were exposed to flying brands. He says:

"In Hamburg alone, even in the parts devastated by fire storms, hundreds of amazing instances of first-aid fire fighting were observed. No doubt there were thousands of similar cases in the many other European cities subjected to air attacks. Bucket brigades up to a quarter of a mile long, manned by determined men, women and children, carried water over rubble heaps through smoke and heat for hours at a time; often water was dabbed on patches of fire in drops with brushes and rags. Windows and doors were blocked with sheet metal and stones to provide improvised fire walls against sparks and threatening flames . . .

"The possibility of providing public fire department crews and equipment to attack area fires after they start is quite limited. For one thing, who would be willing to pay to have them standing by? The few minutes available between the start of many individual fires and their combination into an area fire can be utilized only by the organized groups of people actually on the spot."

He observed that the "self-help" programs of first-aid fire fighting in Germany were often exaggerated and coercive. The programs therefore had fallen into disrepute and first-aid fire fighting was not as well organized as the professional fire fighters would have liked. He comments:

"Still, experience and observations of decades of professional fire fighting show that organization for first-aid fire fighting has always been more effective than the best public fire protection which can be provided. Its great advantage is the time factor: action on the spot often makes it possible to quench a fire with a mere thimbleful of water."

Of these first-aid fire fighting crews he says, however, "They must be sufficiently trained and well-equipped. The equipment must not be limited to primitive equipment, such as fire beaters, buckets and sand." He recommends that they be provided with small portable power pumps with first-aid hose which are easy to handle and do not require much fuel. He says also that because operations which are involved in first-aid fire fighting call for strenuous physical effort, such duties should be assigned, wherever possible, to persons physically fit to perform them.

Emergency Water Sources

At most of the German cities attacked from the air, water main breaks due to explosive bombs were numerous so that, in general, the fire fighters could not depend on the ordinary municipal water system for fire fighting. The German fire department authorities apparently were not able to embark upon as elaborate a program of providing street tanks with static water as did the British. This was principally

Photo courtesy H. Brunswig

Half-Tracks Don't Make It. This is a picture of a heavy half-tracked vehicle stuck on a pile of rubble. From this position it could not move under its own power and had to be towed out backwards.

due to lack of materials. Chief Rumpf says the need for static water was early recognized but there was no concrete for the construction of the necessary reservoirs. Chief Schlieman says that Hamburg, for example, had an abundant water supply from the Elbe River, the various basins of the harbor, the inland basin of the Alster, and numerous canals and other channels all over the city. In this respect, it was more fortunate than some other cities. It had, in addition, 130 static water basins containing 250 to 500 cubic meters (66,000 to 132,000 U. S. gallons) of water. Pumping facilities were provided near the canals and other channels. There were some pipelines permanently installed for fire fighting purposes.

In Hamburg, and as a general recommendation, the German fire authorities tried to keep the distance from the scene of a fire to the nearest water supply not over 250 meters (about 800 feet).

Chief Rumpf observed that 300 to 1,000 cubic meters (80,000 to 250,000 U. S. gallons) of water are needed to supply each fire department pumper put into use. All of the German fire officers quoted appear to have been thinking of static water reservoirs with a minimum size of 500 cubic meters (132,000 U. S. gallons).

These figures, of course, are based on experience in West German cities in the kind of attacks experienced in World War II. They provide an indication of the order of water required but should not, of course, be applied without the exercise of judgment to other cities.

Chief Brunswig describes two methods which were used to calculate the amount of water to be provided for fire department use in various locations. One method is to calculate 5,000 liters (1,320 U. S. gallons) for each floor of each major building. Another method for figuring fire department demand is 50 liters per minute for each meter of street frontage. This works out about 400 U. S. gallons per minute per 100 feet.

The comment of German authorities on pipes laid in streets is that such pipelines, with joints for quick coupling, proved useful from a number of points of view. They were not extensively used, however, because of the manpower required. Where such pipes were available, however, they reduced friction loss as compared to that in long lines of hose but their main value was that they provided water conduits with much greater resistance to mechanical injury than fire hose.

Firemen's Personal Clothing and Equipment

Chief Rumpf's dramatic descriptions of the hot wind, dust, and rain of sparks which accompany a great fire, show that much greater attention must be given to firemen's clothing and personal protective equipment. Chief Schlieman observes that in the vicinity of some fires, and in the fire-storm area particularly, even open park spaces, as wide as 500 feet, were frequently not sufficient to enable them to be places of refuge from the heat of the fires. The best places of refuge were offered by parks with green bushes, providing there was sufficient water for the refugees to moisten their clothing again and again, in order to protect them against the rain of sparks and against the great heat. There was a great

deal of loss of life due to heat and sparks in locations relatively remote from the buildings actually burning.

While loss of life in buildings was frequently due to suffocation, carbon monoxide poisoning and heat, Chief Brunswig reports, "Outside of buildings, lack of oxygen and carbon monoxide poisoning were rarely responsible for deaths. But much loss of life can be blamed on the great amount of dust and flying brands in the air, resulting in inflammation of the eyes and blindness, and hence in the complete helplessness of those affected." The need for equipping firemen with goggles was therefore one of the first lessons learned in the great fires of World War II. The fires also emphasized that firemen's helmets be "of a type for eye, ear and neck protection."

Chief Schlieman describes a difficulty that arose in connection with firemen's clothing and personal equipment. He reports that boots and shoes suffered a great deal in the firemen's work and that it was very difficult to replace or repair them. After the great fire raids there was sufficient leather available but all the shoemakers' workshops were demolished and very few shoemakers were left to do the repair work.

Hose

German practice, with respect to the use of hose, was to use one size of hose approximately 3-inch and another approximately 2-inch. The 3-inch hose was used for bringing the water near to the building on fire and the 2-inch hose lines were used by firemen. In peacetime, Chief Brunswig reports, about 57 percent of fire department hose would be 3-inch and 43 percent, 2-inch. During the war, the percentage of 3-inch hose went to a little over 60 percent and the 2-inch hose to slightly less than 40 percent. The exact amount of hose carried on individual engines often deviated from these figures, he said. An individual hose wagon would commonly carry 35 percent 3-inch hose and 65 percent 2-inch. The wartime fire companies approximately reversed these percentages. The German practice of 3-inch and 2-inch use provided water ways of approximately the same order as the 2½- and 1½-inch hose lines used by U. S. and Canadian fire departments.

Before the great fire raids occurred, fire departments figured on an average hose loss at air raid fires, through damage, at 15 to 20 percent. This is based on statistics kept in Hamburg. In 1943, the year of the great fires, 50 miles of fire hose was lost in that city.

Chief Schlieman describes the loss of reserve hose also, because it was stored in buildings which burned. Much hose was lost, he says, in collapsed walls and in situations where firemen had to abandon hose due to fire spread. The usual mechanical injuries were due to glass splinters and the passing of motor vehicles over hose lines. In wartime fires, there is not opportunity to properly clean and dry hose.

Gasoline Supply

Chief Schlieman reports that the gasoline supply was a major problem at the great fires at Hamburg. Many of the bulk stations, normally used for supply, were either hit by bombs or could not be reached because the streets were blocked by ruins. All this occurred at a time when the demand for gasoline was extraordinarily large, in view of the many firefighting units from outside of the

Photo courtesy H. Brunswig

Tractors Cannot Climb Rubble Piles. This light armored tractor was just able to make its way over a point where two piles of rubble met. The tractor could not climb either of the piles at the side because the tracks merely churned up the loose rubble. This picture was taken directly behind the main fire station at Hamburg.

city. Most of these arrived with very little gasoline left in their tanks. The authorities controlling the distribution of gasoline gave the fire department vehicles a high priority with the result that practically no motor pump was stopped for want of gasoline, but it was a problem to assure an adequate emergency gasoline supply. He recommends that individual fire department vehicles carry extra gasoline and that the fire department have its own gasoline tank trucks.

Temporary shortage of lubricating oil proved to be much more serious. It was finally met by bringing a supply in from a neighboring city.

Fire Prevention Measures

Fire companies which are used to handling a small fire or a fire in a single building are faced with what first appears to be completely overwhelming odds when they approach the kind of fire situation which is presented in wartime. All of the German authorities, however, indicate that certain things can be done and in the foregoing paper I have attempted to enumerate some of the things which these authorities regard important. All of these stressed the importance of pre-raid fire prevention work.

None of them mentioned the importance of clearing rubbish out of backyards and vacant lots but this is due to the fact that German cities do not tolerate conditions as they are tolerated in cities in the United States and Canada. Chief Schlieman called attention to the fact that the work of the first-aid fire fighters in dealing with small fire bombs was

made easier when attics of residential blocks were cleared of all rubbish and old furniture and when the wooden frames of roofs were painted in such a way as to give a degree of fire resistance.

The situations which gave the fire departments the most trouble were an occasional wooden shed in a backyard or where lumber was stored between buildings. The fire crews expected wooden buildings to burn as a matter of course. Chief Schlieman points out, also, that metal-working occupancies normally were considered to be reasonably safe because of the low fire hazard. He testified that where manufacturing buildings had wood roof decks, even where the occupancy was low hazard as in a metalworker, the small fire bombs set fire to the roofs and destroyed the buildings. Chief Schlieman also points out that storage of lumber under viaducts and bridges, and wooden tool sheds under such structures, frequently permitted considerable unnecessary damage to unprotected steel structures.

The lesson of all this experience is that North American cities must be not only cleaned of unnecessary combustible rubbish accumulations but that unnecessary wooden construction must also be removed. Lumber yards are a particular source of trouble.

A further word must be said to emphasize the size of the wartime fires with which fire departments are likely to be concerned. It is obvious that very large areas of cities are being considered. The statistics on Hamburg, furnished by both Chief Schlieman and Chief Brunswig, give an idea of the order of fires of which we are concerned. The great attack of

Photo courtesy H. Brunswig

A Recommended Chassis Type. This is a truck of the Mercedes-Benz-Unimog type which was found to be best for work in rubble areas. This chassis, with 4-wheel drive, proved fairly satisfactory because of generous ground clearance. Nevertheless, it was possible to climb this pile of rubble only by putting snow chains on the tires because otherwise loose rubble was too readily churned up by the moving wheels.

Photo courtesy H. Brunswig

"Portable" Pumps. Chief Brunswig says what many American fire officers have said, namely, that trailer pumps and "portable" pumps are not very useful because they are not really portable. He submits this photograph of six firemen attempting to maneuver a relatively light portable pump of about 350 pounds down a slope to a water source. He praises recent attention to better design of portable pumps.

the 27th and 28th of July 1943 on Hamburg set fires over an area of 17 square miles and there was an area of concentrated fire of 5.1 square miles, but most significant perhaps is the fact that the street frontages involved in this great fire totalled 133 linear miles. Visualize a street 133 miles long with every building on one side involved! Street frontages in the first large fire attack on Hamburg totalled 54 miles and in one succeeding attack, 104 miles.

Chief Brunswig observes:

"The majority of all area fires during the centuries were finally stopped by natural obstacles such as rivers, parks and open spaces. But, in many cases, sturdy fire walls offered the fire-fighting units a place to make a stand. More often than not, these measures of fire control, which owners and architects regard unimportant, stopped the fire. The extent of the catastrophes of World War II often left the opinion that building safeguards of this kind are more or less valueless. But the study of those cases where a building or group of buildings remained standing in the midst of area fires clearly shows how erroneous is such a viewpoint.

"The construction of firebreaks has often been discussed as a radical means for limiting area fires. In the Hamburg conflagration of 1842, attempts were made to produce such intervening spaces by means of blasting. They were completely unsuccessful. The number of persons killed in the course of the blasting operations represented about one-third of the total number of victims of the fire. A hundred years later, in 1942, the construction of a firebreak in the Altona district of Hamburg was considered. The plan was not carried out. The events of 1943 would, in any case, only have shown the uselessness of such an undertaking."

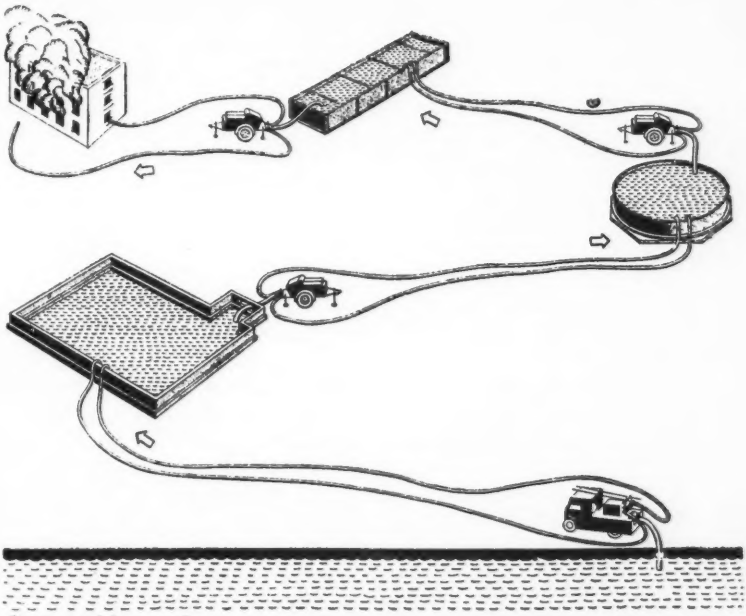
Chief Brunswig is referring to the fact that incendiary bombs would have fallen on both sides of such a firebreak. Chief

Schlieman also expressed the conviction that attempting to control fires in the city by clearing blocks with explosives was impractical because of the large force of men that would be required to perform such an operation successfully and because it could not be accomplished in time.

Speaking further about firebreaks, Chief Brunswig observes, "On the basis of the experience gained in the war, such a firebreak in the heart of the city would have to be at least 100 meters (328 feet) wide. It would also have to be planted with trees for heat insulation and as spark catchers."

Lessons of the Great Fires

This paper has been necessarily limited to discussing certain details of wartime fire department work on which we have valuable observations of some distinguished German authorities. It neglects a number of problems which must be considered in wartime operations. A few words have been said about firemen's



Crown copyright reserved

Pumper-to-Tank Relays. When water relaying is to be done, it should embrace a method as simple as possible. A recommended method is for one pumper to pump to a tank and the next pumper to take up the relay by suction from the tank. This drawing is from the Manual of Firemanship, Part III, Water Supplies, published by the British Home Office Fire Service Department, 1943, 122 pages. The drawing shows street tanks typical of designs used by the British fire services. The German fire officers recommended this same general method of water relaying.

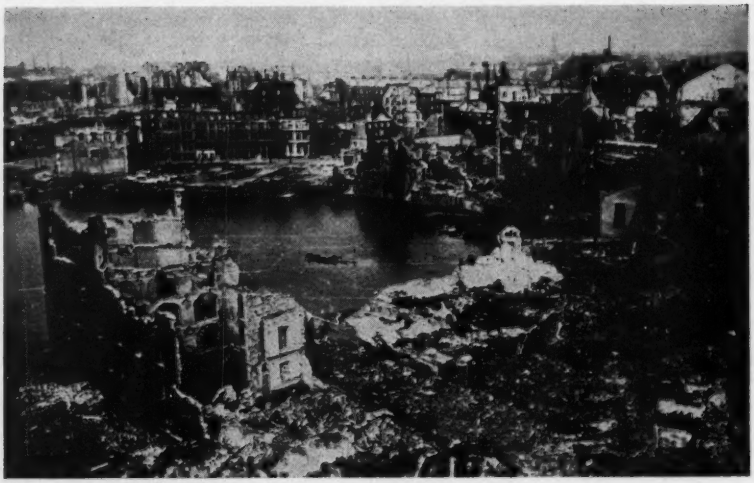


Photo courtesy H. Brunswig

Fire Straddles "Firebreaks." Most cities have parks, open spaces, or even bodies of water like this one in a section of Hammerbrook, a district in Hamburg where destruction was due to the attack of the night of July 27, 1943. "Firebreaks" had limited value in incendiary attacks which could straddle such open spaces. The experience at Hamburg showed that open spaces had to be considerable to be of value. Open park spaces as wide as 500 feet were frequently not sufficient to enable them to be places of refuge for people. The German authorities report that to be of value in fire fighting, "firebreaks" would have to be at least 300 feet wide and be planted with trees to give protection against heat and flying brands.

personal clothing and equipment. There is the additional problem of feeding fire crews which operate for long periods away from their normal eating places and of providing emergency shelter and rest facilities. The provision of food and housing for firemen is left to them individually in peacetime. With widespread destruction and with the need for fire fighters working around the clock, wartime facilities for food and housing must be provided, keeping in mind that fire stations as well as homes are going to be destroyed.

The overall organization for wartime fire fighting does not show up as a problem very strongly in the German experience because German fire departments had achieved, before the war, a considerable measure of integration into large forces. Nevertheless, all of the fire department officers quoted, explain the difficulty in using individual small fire companies because such companies are not used to operating as part of a large organization and because they do not have chief officers capable of managing the work of dozens of companies.

The important difference between wartime and peacetime fires is, of course, their scale. It was clear from the British experience that wartime fires affected fire department operations far beyond the limits of any individual municipality.

This led to the fire brigades being taken away from the local authorities and put under state control.

The German experience is quite similar. It was not only a matter of moving fire companies into a city, as outside aid, but a question of effective operation of individual companies under the direction of officers capable of using them according to an effective plan.

It is also perfectly clear, from reports which have been published of the effects of A-bombs and H-bombs, that these extend over such a huge territory that the control of fire companies by individual municipalities may not even enable the fire companies to protect themselves from blast, fire and radiation hazards, let alone doing any fire fighting. The area affected by a large nuclear weapon discharged on a city target may be so great that the only conclusion one can draw is that fire departments must be put under state control if the units available are to be effectively protected against loss and mobilized for fire fighting where such operations can do some good.

Each of the states should immediately begin plans to set up a state fire staff and arrange for the orderly integration of existing municipal fire departments into a statewide organization. Similar action, province by province, would be appropriate in Canada.

This has got to be something more than a loose mutual aid arrangement. A number of states, among them New York, California and Oregon already have legislation making this possible. It calls, in each case, for the fire departments to go under state control upon a simple declaration of emergency by the governor.

Even this is not quite enough. A major lesson of the wartime fires is that fire crews must work together in an organization long enough so that they can fully understand their part in the over-all action. In other words, there has got to be a period of several years, at least, which is a sort of shakedown period. Such a shakedown period is necessarily a period of confusion and adjustment. It must be behind us when our fire departments face fires of the tremendous scale produced by modern war.

References

The following is a list of the papers and publications mentioned in the foregoing article. Several of these references are out of print. Where publications are currently available from the publishers a price is given where the price is known. Some of the references may be available in libraries of some fire departments or in other collections.

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Municipal Fire Administration. Published by International City Managers' Association, 1313 East 60th St., Chicago 37, Ill. 498 pages. Fifth Edition, 1950. $7.50.

The Auxiliary Fire Service and Its Operation. Harold Bevir. Published by National Fire Brigades Association, 28 Russell Sq., London, W.C.1, England. 316 pages. 1940.

Experiences of the Fire Brigade During the Air Raids on Hamburg, July 24th to August 3d, 1943. Doctor Engineer Colonel William Schlieman, second in command, Hamburg Fire Brigade. Unpublished English translation of a manuscript. 1945.

Area Fires and Fire Storms (Flächenbrände und Feuerstürme). H. Brunswig, a chief officer (Oberbrandrat), Hamburg Fire Brigade. In German. Published in VFDB-

Zeitschrift (quarterly magazine of the German Fire Protection Association), W. Kohlhammer, publisher, Urbanstrasse 12, Stuttgart O, Germany. Vol. I, No. 1, June 1952.

Fire Bombs (*Brandbomben*). Hans Rumpf. In German. Published by E. S. Mittler & Sohn, Berlin. 1931.

The Pros and Cons of World War II (*Bilanz des Zweiten Weltkrieges*). In German. Published by Gerhard Stalling, Oldenburg, Germany. 1953.

The Bright Red Rooster (*Der Hochrote Hahn*). Hans Rumpf. In German. Published by E. S. Mittler & Sohn, Schofferstrasse 15, Darmstadt, Germany. 172 pages. 1952. 9.20 deutschmarks.

Manual of Firemanship. Series of volumes compiled by the British Home Office, Fire Service Department. Published by Her Majesty's Stationery Office, London (available in U. S. from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y.). Part 1, 262 pages, 1943, 4 shillings ($1.00). Part 2, 188 pages, 1944, 4 shillings ($1.00). Part 3, 122 pages, 1943, 3 shillings (75¢). Part 4, 144 pages, 1948, 2 shillings, 6 pence (65¢). Part 6A, 256 pages, 1945, 4 shillings ($1.00). Part 6B, 176 pages, 1945, 3 shillings (75¢). Part 7, 152 pages, 1944, 4 shillings ($1.00).

The Fire Services. A document giving data on the current organizational status of British fire services. Fourth Report from the Select Committee on Estimates, British House of Commons, Session 1953-54. Published by Her Majesty's Stationery Office, London (available in U. S. from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y.), 210 pages, 8 shillings ($1.80).

Role of the Fire Service in National Defense. By Boris Laiming. The Firemen's Grapevine, published by Los Angeles Firemen's Relief Association, Inc., 644 South Figueroa St., Los Angeles, Calif. April 1951 issue.

Chief Tells Experiences in Hamburg Firestorm. By Boris Laiming. The Firemen's Grapevine, published by Los Angeles Firemen's Relief Association, Inc., 644 South Figueroa St., Los Angeles, Calif. October 1952 issue.

Conflagrations in America Since 1900. Published by National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. 64 pages, 1951, $1.00.

Correction

The report of the large loss warehouse fire at Edgewater, New Jersey, published on Page 229 of the January 1955 *Quarterly*, contained the statement, "The building had formerly been protected by sprinkler systems and the equipment was still intact, except that the water supply had been disconnected." Since publication of the January *Quarterly* we have been advised by the Fire Insurance Rating Organization of New Jersey that the sprinkler system was in service, but that it failed to control the fire due to a combination of circumstances. The following is a corrected report:

***June 1, Edgewater, N. J. Hudson River Properties, Inc. $1,200,000**

Two pier warehouses, vacant industrial building. Two communicating 1-story wood-framed metalclad pier sheds with a total area of 103,000 sq. ft. were destroyed along with an adjacent 30,000 sq. ft. 2-story industrial building. Children swimming and smoking at the end of the pier probably started the fire which had entered the undivided pier shed, in which 100 new cars and six used trucks were stored, before discovery. The sprinkler systems that protected the building failed to control the fire for the following reasons:

a. The fire originated outside of the building.

b. The fire entered the building at the most remote point (approximately 600 ft.) from the dry pipe valves.

c. It is highly probable that there was excessive air pressure in the sprinkler systems.

d. Brisk, gusty wind blowing through broken windows and through holes in the walls and roof spread the fire rapidly through the interior.

e. There were no fire walls or draft stops in the high 930-ft.-long building.

Meeting of Board of Directors

New York, January 27, 1955

Present

Richard E. Vernor, Chairman
T. Seddon Duke, President
John A. Neale, Vice-President
Henry G. Thomas, Vice-President
Allen L. Cobb, Past President
Hovey T. Freeman, Secretary-Treasurer

Warren J. Baker	A. Leslie Ham
A. L. Brown	J. Sharp Queener
E. Kenneth Clark	Elmer F. Reske
P. E. Dannenman	Geo. J. Richardson
Franklin R. Fetherston	Frank D. Ross
E. Gaston	Roger H. Wingate

Percy Bugbee, General Manager; Robert S. Moulton, Technical Secretary; Horatio Bond, Chief Engineer; Charles S. Morgan, Assistant General Manager; M. M. Brandon, Chairman, Electrical Section; Edward Royal, Advertising Council.

Memorial Tributes

Chairman Vernor opened the meeting with a memorial tribute to Franklin Wentworth and Alvah Small, Honorary Members, who had died since the last meeting of the Board.

1955 Annual Meeting

1. Messrs. Bugbee and Morgan reported on program and plans for the 59th annual meeting of the Association, Hotel Netherland Plaza, Cincinnati, Ohio, May 16-20, 1955. This report was approved and the Executive Office was directed to proceed accordingly in further development of the meeting program.

Finances

2. Treasurer Freeman reported on the finances of the Association, indicating an excess of expenditures over income for the first eight months of the fiscal year, in accordance with normal experience, and presenting a projection of anticipated income and expense for the fiscal year ending April 30, 1955 which reflected an anticipated small surplus for the year.

Executive Office Activities

3. Reports on Executive Office activities were presented as follows:

(a) Mr. Bugbee reported total membership as of January 1, 1955 of 15,743 with a net gain of 533 members during the year 1954. He reported on the continuous membership campaign conducted by Membership Committee Chairman H. E. C. Rainey.

(b) Mr. Bugbee reported on the Field Service Sponsors Committee, reporting the acceptance of chairmanship by Colby M. Chester of the General Foods Corporation, and the increasing success of the fund-raising campaign.

(c) Mr. Moulton presented information on NFPA publications, indicating that the income from the sale of publications, together with associated advertising income, represents more than half the total income of the Association and that to this extent the educational activities of the NFPA are self-supporting. He reported an income from publications sales of $238,775 from May 1 to January 1, 1955, a distribution of approximately 5,000,000 pieces of Fire Prevention Week literature, and an increased activity in the publication of the National Fire Codes, the NFPA Handbook of Fire Protection, and in other phases of the NFPA publications program. Among other items, he reported accrued royalties of approximately $1,000 to be paid the NFPA by the McGraw-Hill Book Company on account of the

National Electrical Code Handbook and stated that such royalties when received would be credited to the Electrical Field Service Fund.

(d) Mr. Morgan reported an increased income from advertising in the QUARTERLY and FIREMEN magazine, and anticipated income from the 1955 printing of the Handbook of Fire Protection.

(e) Mr. Bugbee reported an increased staff and progressively more extensive activities of the Public Relations Department.

(f) Mr. Bond reported on the activities of the Fire Services Department. Mr. Neale questioned certain phases of these activities pertaining to municipal fire departments, and the subject was discussed by Messrs. Duke, Richardson, Thomas, Wingate and others. Messrs. Bugbee and Bond indicated the continuing NFPA policy of coordination and consultation with other agencies concerned with municipal fire protection matters.

(g) Mr. Moulton discussed the Department of Fire Record, indicating the increasing usefulness of this activity and the need for additional personnel.

(h) Mr. Moulton described the status of the NFPA Field Service Projects, which were further discussed by Mr. Brandon (Electrical), Mr. Fetherston (Gases), and Mr. Queener (Flammable Liquids).

NFPA Sections

4. Reports of NFPA Sections were presented as follows:

(a) Chairman Brandon of the Electrical Section discussed plans for handling revisions of the National Electrical Code.

(b) Mr. Morgan reported on meetings and other activities of the Fire Marshals' Section.

(c) President John A. Neale of the Society of Fire Protection Engineers reported on the membership and finances of the Society and the current plans of the Executive Committee for a new class of membership which would provide additional income.

NFPA Regional Meetings

5. Messrs. Duke, Neale and Brown reported on the great success of the NFPA regional meeting in Seattle in September 1954. It was voted to extend to Chief Fitzgerald of the Seattle Fire Department the thanks of the Association for his service as Chairman of the Sponsoring Committee for the Seattle meeting. General discussion indicated the belief of the Board that regional meetings constitute an important and worth while part of the NFPA program and should be continued and expanded as opportunity presents. Mr. Moulton then reported on plans for the next regional meeting in New Orleans, November 28-30, 1955, and expressed the hope that many of the members of the Board would attend.

"Sparky"

6. Mr. Royal, Account Executive for the Advertising Council, explained the Advertising Council's method of operation in public service projects and presented exhibits illustrating various phases of the highly successful operation of the Fire Prevention Campaign for which the NFPA is sponsor, and Sparky, the fire house dog, is the symbol.

7. Mr. Bugbee reported on developments in the use of Sparky in commercial enterprises. As royalty incomes accrue from these projects to the NFPA they will be used in furtherance of the Advertising Council campaign. This is in accordance with the authorization of the Board at the January, 1954 meeting when the Board approved the execution of a contract with V.I.P., Inc., of New York to represent the NFPA on negotiations for commercial contracts for the use of Sparky. To date the following contracts have been executed by V.I.P.: (a) the Ideal Toy Corporation to manufacture Sparky toys; (b) Rand McNally and

Company to manufacture books; (c) Award Incentives, Inc., to manufacture jewelry such as pins, necktie clips, cigarette lighters, key rings, etc.; (d) Fire and Police Manufacturing Corporation to manufacture hats and monograms; (e) the Osborne Company to manufacture calendars, blotters, ash trays and other advertising specialties; (f) Eric Jon Associates to manufacture comic books and other visual booklets.

8. Mr. Bugbee described the establishment of Sparky's Fire Department for children as a desirable adjunct to the Fire Prevention Campaign conducted by the Advertising Council. The Sparky Fire Department kit consists of a letter, a badge, a membership card, and a manual of instructions. Children can write in to Sparky's Fire Department, Boston 1, Mass., sending 25¢, and receive automatically this material.

Technical Committee Activities

Sprinklers for Ships

9. Mr. Ham presented the report of the special Board Committee on NFPA Standards on Sprinklers for Ships (Mr. Ham, Chairman, Mr. Cobb and Mr. Wingate), which had been appointed by Chairman Vernor pursuant to the action of the Board at its last meeting.* The report was accepted and the committee was discharged with an expression of appreciation. After discussion, it was voted to cooperate with the U. S. Coast Guard in respect to the revision of their regulations on the details of sprinkler installation on shipboard. The discussion, participated in by Messrs. Ham, Cobb, Wingate, Brown, Duke, Neale, Fetherston and others, indicated that this action was taken without prejudice to future NFPA activity in this field, and reflected the view that the NFPA has an inherent right to develop standards on any phase of fire protection irrespective of whether or not there are government regulations applicable to the subject; also that it may be desirable to maintain NFPA activity on subjects covered by government regulations in order to provide means for expression of opinion and the offering of advice.

Discussion by Mr. Brown, Chairman of the Technical Advisory Committee, included the thought that in matters such as this the NFPA has a two-fold responsibility, one to recommend where protection is needed, and the other to recommend how it should be installed where needed. He indicated that the inception of the NFPA activity on this subject may have resulted in some misunderstandings and confusion because we appointed a conference committee to prepare standards on methods of sprinkler installation on shipboard in accordance with the instructions of the 1952 annual meeting without any recommendation as to where sprinkler protection is needed.

The status of the Conference Committee on Sprinkler Installations on Shipboard was discussed without action, thus continuing the Conference Committee with the understanding that it will serve as a means for cooperation with the Coast Guard, and will provide the committee machinery for any further NFPA activity on this subject that may be indicated.

Industrial Committee

10. Chairman Cobb of the Industrial Committee reported on the activities of the committee, including the need for enlargement of the personnel of the committee. The Industrial Committee also recommended that the NFPA create a new Committee on Industrial Fire Apparatus to prepare standards on special types of mobile fire fighting equipment for industrial use not covered by the Committee on Fire Department Equipment or any other present committee. This recommendation was referred to the Technical Advisory Committee for consideration and report to the Board.

Wearing Apparel

11. Chairman Wingate of the Committee on Wearing Apparel reported

*See July 1954 Quarterly, page 18.

progress in the activities of this committee. He reviewed the situation in respect to national and state legislation on the combustibility of wearing apparel, the results of the influence of the NFPA in this field, the cooperation that the NFPA is now receiving from various branches of industry, and the need for further development of improved testing procedures. After discussion, it was voted not to accept the invitation of the U.S. Department of Commerce to appoint a representative to the committee responsible for the U. S. Commercial Standard on Combustibility of Wearing Apparel, now used as the basis of federal legislation, on the ground that a commercial standard is not a proper basis for regulations in the interest of public safety. It was felt that participation in such a committee project might be interpreted as implying NFPA concurrence in procedures and standards which are not consistent with the NFPA position in respect to the public interest.

Committee Meetings

12. Mr. Moulton reported on technical committee activities, mentioning a total of 49 committee sessions in New York during the 10-day period concurrent with the Board meeting. A fine spirit of cooperation was noted on the part of nearly 2,000 committee members contributing their services in the public interest through membership on a total of over 100 NFPA committees.

Technical Advisory Committee Reports

13. The report of the Technical Advisory Committee was accepted as presented by Chairman Brown, with action on recommendations therein, as follows:

(a) After extended discussion, the following Procedure for Adoption of Standards at NFPA Annual Meetings was adopted, subject to such editorial changes as may be found necessary to clarify the intent, this procedure to be integrated with the Regulations on Technical Committee Procedure printed in the NFPA Year Book. Discussion by Mr. Fetherston and others indicated some concern that under this procedure, as well as under present procedure, well-considered technical committee reports might be superseded by uninformed action of the annual meeting. However, in the absence of any record of improper action by any annual meetings within the memory of those present, and the probable delays in the production of standards that might result from any procedural restrictions designed to prevent ill-considered action, no such restrictions were incorporated in the Procedure.

(1) Technical committee reports proposing new or revised standards to be acted upon by the Association in annual meeting must have received the affirmatively recorded votes of a majority of the committee and must have been received by the NFPA Executive Office by March 15 preceding the meeting and preprinted in the Advance Reports for general circulation to all interested members so that everyone interested will have had opportunity to secure advance notice of proposed action before the annual meeting.

Exception: Reports may be presented without such advance publication by specific authorization of the Board of Directors or by the unanimous consent of the annual meeting. Such unanimous consent pertains only to the presentation of the report; the consent having been granted, it is not necessary that the action in adopting the report itself need be unanimous.

(2) Amendments to reports may be presented by the committee or from the floor of the meeting and acted on without advance notice, provided that no new subject is thereby introduced.

(3) Minority reports may be presented by one or more dissenting committee members. Notice of intention to present such minority reports must be filed in advance of the meeting with the chairman of the committee concerned and with the NFPA office.

(4) Informative or progress reports not proposing action on official stand-

ards of the Association may be presented without advance notice, subject to availability of provision for their presentation on the program of the annual meeting.

(5) The Association in annual meeting may adopt reports as presented, adopt amendments, refer back to committees, reject or table reports as it may desire, but shall not delegate its authority for action on official standards of the Association except to the Board of Directors.

(b) Subdivision of the Committee on Gases into four Sectional Committees was approved as follows: Utility Gas, Liquefied Petroleum Gas, Industrial Gases, Gas Utilization.

(c) The creation of a new Sectional Committee on Solvent Extraction as a part of the Committee on Flammable Liquids was confirmed.

(d) The subject of nonsparking and conductive floors was assigned to the Committee on Static Electricity.

(e) The Committee on Industrial Tractors and Lift Trucks was constituted as an independent committee, its name changed to Committee on Industrial Trucks and its scope amended by insertion of the words "and other material handling equipment."

(f) A change in the name of the Committee on Inert Gas for Fire and Explosion Prevention to "Fire and Explosion Prevention by Inerting" was confirmed.

(g) The subject of garden hose size domestic standpipe and hose sets was assigned to the Committee on First Aid Extinguishers, now changed to "Committee on First Aid Fire Appliances."

Committee Appointments

14. Committee appointments were confirmed in accordance with the list recommended by the Technical Advisory Committee and submitted with the agenda for the meeting; also the supplementary list dated January 20, 1955.

Other Business

15. Mr. Bugbee reported that there were no communications requiring action by the Board, but that certain communications received would be circulated to the Board by mail as a matter of information and interest.

16. Mr. Richardson expressed appreciation to the members and staff of the Association for their support of the International Association of Fire Fighters in their campaign for the benefit of the Muscular Dystrophy Association.

17. It was voted to express the appreciation of the Board to Mr. Freeman for making available the facilities of the Union League Club for the meeting, and for a luncheon also attended by members of the Nominating Committee.

"... It'll Be Tough"

EDITOR'S NOTE

On March 19 fire struck at the one large industrial plant in Sloatsburg, New York. Apparently originating at a dryer in the finishing room, the fire quickly spread beyond control despite efforts of night shift employees and the operation of sprinklers. Full details as to the contributing factors which caused this major loss and the reasons for the failure of the sprinklers to control the fire are not yet available but the following article published in the March 23, 1955 issue of the *New York Herald Tribune* and reprinted here by special permission, tells its own story.

By Paul Tobenkin

SLOATSBURG, N. Y., March 22.—This village of 2,200 persons astride Route 17, the main artery to the Catskills, was in a state of shock today.

The village's one large industrial plant, the Ramapo Piece Dye Works, employing 250 persons, was turned into a brick shell housing a jungle of burned timbers and twisted machines as the result of a spectacular fire which started at midnight Saturday.

Damage at $2,000,000

The loss of the building, the Ramapo plant equipment, and a smaller concern, the Schwartz Yarn Co., which occupied the second floor of the two-story structure, was estimated by the owners of the two firms at $2,000,000.

Employees of the plants, merchants and other villagers, standing in knots watching the still smouldering ruin, are confronted with a major economic catastrophe. Business in the Sloatsburg Inn, a diner and bar across Route 17 from the plant, Richard and Fred Pucillo's drug store and in the Village Market, a grocery and butcher shop, has dropped drastically.

Julius Rutberg, president of the Ramapo company, who has operated it for the last fifteen years, told a few of his employees that he would build a new plant and have it in operation within the next six months. Within hours the village grapevine carried his words to near-by Ramapo and Suffern whose merchants also cater to Sloatsburg residents.

Six Months Is a Long Time

But Mr. Rutberg's words did not entirely allay the villagers' apprehension. The sentiment was that even if all goes well, six months is a long time to be out of work, especially for people who live from one pay check to the next.

Each of the villagers questioned voiced his own concern, but all expressed fear for the plight of the older men. Mr. Rutberg's policy of keeping his employees, even during slack seasons, promoted an unusual feeling of friendship for "Julie" by everyone interviewed. The other side of the coin, however, is that many of his employees, because of age, figure they are just about out of the competitive job market.

The effects of the fire, however, are being felt in New York City and other industrial areas far from this mountain village. The Ramapo plant finished cotton goods — that is, dyed and embossed the material. Completely destroyed by the fire were hundreds of bolts of cotton material, both finished and unfinished, to be sent to clothing firms throughout the country for the manufacture of spring dresses.

40 Firms Affected

The spring dress season has already started and the forty firms for which Ramapo finished cloth either had their materials lost or will be unable to complete arrangements with other finishing plants in time for this season's sales.

Walter Fox, of Perles-Fox Corp., 160 W. 36th St., New York, cotton textile converters, drove up to see whether any of his materials could be salvaged. Not a single bolt of his cloth remained. Even though his dollar loss for the material is covered by insurance he has lost out on a major selling season.

in Sloatsburg for Awhile

Al Rhoades, Photographer

The ruins of the Sloatsburg Ramapo Piece Dye Works

The destruction of the plant and the possibility of building a new one, has made the town tax conscious. The Ramapo plant and the Erie Railroad are the two largest taxpayers in Sloatsburg, together contributing a major share toward the village's $81,000 annual budget.

The Tax Problem

However, with people out of work —most of those in the plant owned their own homes—they will not be able to pay the local property taxes. Further, if Mr. Rutberg is to build a new plant, the village's five trustees, the government body, are aware they will have to make some tax concession to him. This adds up to the fact that local taxes will have to be raised at a time when business activity is below normal.

Most of the employees are natives of Sloatsburg, mountain people whose avocations are hunting and fishing. Typical of them is Don Brentnall, twenty-five, who lives with his wife, Frances, their six children ranging up to six years, his widowed mother and a sister in an old, five-room house within 100 yards of the plant.

While the fire was going full blast, Mr. Brentnall was one of the 300 men who fought it and succeeded in saving an office shed and a warehouse. Now, with nothing really to be done, he seemed lost.

When the Plant Reopens

"I'll have to get another job, but I don't know where," he said. "When the plant reopens I'll come back. My father, who died in 1946 worked in this same plant for twenty years under the former owners. I guess I'd be lost any place else."

Richard Pucillo, the druggist, summed it up. "Sure it's a hard blow for working people. Sure taxes will go up. Sure it'll be tough for awhile. But we survived wars and depressions and we'll survive this."

Fire Record of Cities, 1954

As Reported by Municipal Authorities

The following tables summarize fire department reports for 1954 in 650 of the 699 cities with population over 20,000 in the United States and Canada.

These statistics have been collected and published in the April QUARTERLIES since 1939. These tables should not be used as a basis of comparisons among cities, as comparisons based on these statistics may be misleading if used without a full understanding of the many factors which should be taken into consideration in making any comparisons between cities. The principal discrepancy results from the wide variation among fire officials as to what constitutes a fire loss. Certain reports include only insured losses, others only uninsured. Whether or not property is insured, of course, has no bearing on the actual value of property destroyed. Variations in degree of industrialization, differences in topography, climate and age of cities also influence the fire record. In other words, fire losses reflect the composite results of many different factors in addition to fire department efficiency and therefore the practice of making comparisons among different cities based on these data is to be discouraged.

Fire departments of 548 United States cities and 48 Canadian cities of over 20,000 population have reported their estimates of fire loss, fire alarms, building fires, and false alarms for 1954 to the NFPA Department of Fire Record.

A total of 582 United States cities having more than 20,000 population reported a fire loss for the year 1954 of $225,776,898. Fifty-two Canadian cities having a total population of 5,136,253 reported a loss of $23,180,431 for 1954.

The average loss per person in the 582 U. S. cities reporting losses was $3.61, 6.5 per cent less than the $3.86 average loss in 1953. The per capita loss in the 52 Canadian cities reporting losses was $4.51, an 0.9 per cent increase from 1953.

The average loss per building fire in 497 U. S. cities for 1954 was $943, compared with $867 in 1953. The average building fire loss in 42 Canadian cities was $1,028 in 1954, $1,075 in 1953.

The total number of building fires reported by 581 U. S. cities was 251,681, an average of 3.9 fires per 1,000 population, as compared with 4.2 building fires per 1,000 population in 1953 and 4.3 in 1952. Forty-nine Canadian cities reported 20,183 building fires in 1954. The number per 1,000 population was 4.0 in 1954 as compared with 4.1 in 1953.

Motor vehicle fires reported by 577 U. S. cities totaled 63,805, an average of 0.99 fires per 1,000 population. Forty-nine Canadian cities reported 2,827 motor vehicle fires, or 0.57 per 1,000.

Fire departments in 588 U. S. cities of more than 20,000 population answered 878,641 alarms in 1954. The number of alarms in 52 Canadian cities was 57,115.

In the United States, 586 cities of over 20,000 reported 65,375 false alarms in 1954. This was 7.4 per cent of the total calls. It will be noted that these are "malicious false alarms," not cases where smoke or steam, etc., was honestly mistaken for fire. The 6,931 false alarms reported by 50 Canadian cities were 12.1 per cent of their total calls.

Fire departments have been very cooperative in furnishing fire loss figures. Most of the 49 nonreporting cities did not record their fire experience. A number of loss figures are preliminary estimates.

1954 FIRE LOSSES, CITIES OF 20,000 POPULATION AND OVER

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
ALABAMA							
Anniston	31,150	79,752	687	178	57	17	5.7
Bessemer	28,471	.....	.....	.....	.....	.....	.....
Birmingham	298,720	1,200,412	5,375	1,242	253	436	4.2
Dothan City	21,556	100,875	447	164	41	6	7.6
Florence	23,832	.....	.....	.....	.....	.....	.....
Gadsden	55,528	272,447	1,134	215	55	99	3.9
Mobile	127,151	671,791	1,707	660	127	124	5.2
Montgomery	195,098	376,068a,d	1,536	562	95	80	2.9
Phenix City	23,285	.....	.....	.....	.....	.....	.....
Selma	22,629	108,384	201	118	17	10	5.2
Tuscaloosa	46,364	125,112	642	247	66	28	5.3
ARIZONA							
Phoenix	105,042	340,234c	1,828	494	160	70	4.7
Tucson	45,064	486,597	950	107	67	86	2.4
ARKANSAS							
El Dorado	23,047	217,532	494	135	46	29	5.9
Fort Smith	47,864	278,655c	1,214	191	.....	78	4.0
Hot Springs	29,298	136,605	458	139	40	6	4.7
Little Rock	101,387	.....	.....	.....	.....	.....	.....
North Little Rock	42,142	315,285	1,226	233	58	24	5.5
Pine Bluff	37,147	238,100d	771	299	49	10	8.1
CALIFORNIA							
Alameda	63,425	76,092	747	201	40	91	3.2
Alhambra	51,284	34,006	439	94	55	50	1.8
Arcadia	23,041	57,671	369	55	28	2	2.4
Bakersfield	34,540	206,207	825	169	87	98	4.9
Berkeley	113,217	273,678	1,796	510	137	75	4.5
Beverly Hills	28,915	181,455	375	142	52	13	4.9
Burbank	78,318	140,447	701	290	98	3	3.7
Compton	47,893	250,270	620	149	65	7	3.1
Eureka	22,913	43,541	317	142	29	60	6.2
Fresno	90,618	283,225	834	195	82	125	2.2
Glendale	95,398	133,869	871	285	103	64	3.0
Huntington Park	29,376	.....	207	32	40	15	1.1
Inglewood	46,046	68,892c	400	152	74	14	3.3
Long Beach	244,072	298,055c	1,900	782	220	56	3.2
Los Angeles	1,957,692	.....	26,862	8,676	2,380	1,789	4.4
Los Angeles County	2,193,995	4,993,827	10,579	2,288	915	483	1.1
Lynwood	25,534	44,489c	406	77	82	13	3.0
Menlo Park Fire Dist.	55,000	79,871	810	161	52	20	2.9
Monrovia	20,274	284,190	310	72	22	6	3.5
Montebello	21,754	7,871c	259	57	32	5	2.6
Monterey Park	20,113	38,898	279	76	20	7	3.8
National City	21,132	9,806	182	30	22	1	1.4
Oakland	380,576	1,103,351	4,946	1,485	349	659	3.9
Ontario	22,823	31,674a,c	257	79	36	0	3.5
Oxnard	21,159	100,340c	126	68	26	4	3.2
Palo Alto	25,290	66,882	536	153	61	23	6.1
Pasadena	104,085	71,450c	1,009	377	142	83	3.6
Pomona	35,157	252,155	623	76	44	3	2.2
Redondo Beach	25,208	101,600	354	106	52	11	4.2
Redwood City	25,342	192,340	1,025	80	57	34	3.2
Richmond	99,218	163,038	1,668	367	90	51	3.7

a. Estimated. c. Building and contents only. d. Insured loss only.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
CALIFORNIA (Continued)							
Riverside	46,399	214,824c	572	161	58	11	3.5
Sacramento	135,761	626,000b,c,e	1,637	642	141	174	4.7
San Bernardino	62,792	115,767c	808	232	101	30	3.7
San Diego	321,485	753,076a,c	3,172	1,167	305	150	3.6
San Francisco	760,753	.....	10,660	3,456	475	1,590	4.5
San Gabriel	20,204	15,017	118	47	18	1	2.3
San Jose	95,044	640,549c	1,348	199	39	133	2.1
San Leandro	27,498	98,913	362	84	34	6	3.1
San Mateo	41,536	120,774	636	156	59	18	3.8
Santa Ana	45,534	60,301c	549	158	50	45	3.5
Santa Barbara	44,764	51,759	571	149	55	33	3.3
Santa Cruz	21,848	62,018	325	66	21	11	3.0
Santa Monica	71,299	86,376	993	262	86	58	3.7
South Gate	50,684	166,746	399	196	101	7	3.9
Stockton	71,660	357,789	1,282	274	101	57	3.8
Torrance	22,206	213,447	626	125	44	18	5.6
Vallejo	23,164	120,031	590	118	36	81	5.1
Whittier	23,866	27,842	265	84	22	2	3.5
COLORADO							
Colorado Springs	45,268	35,021	502	227	66	40	5.0
Denver	412,856	1,055,942	4,276	1,719	340	305	4.2
Greeley	21,000	16,406c	242	89	38	4	4.2
Pueblo	63,561	84,493c	659	341	85	48	5.4
CONNECTICUT							
Bridgeport	159,352	582,359	1,735	582	266	81	3.7
Bristol	35,893	200,683c	518	137	68	41	3.8
Danbury	22,424	20,494	444	175	39	15	7.8
East Hartford	29,340	83,595c	485	79	.....	14	2.7
Fairfield	30,370	18,117	204	16	12	2	0.5
Greenwich	40,546	151,824	1,170	155	48	10	3.8
Hamden[1]	29,311	39,691	520	33	34	24	1.1
Hartford	177,073	513,810c	2,463	549	278	192	3.1
Manchester	33,906	.....	.....	.....	.....	.....	.....
Meriden	43,747	294,415	535	165	63	33	3.8
Middletown	29,665	.....	295	115	.....	21	3.9
Milford	26,345	98,019	717	160	41	17	6.1
New Britain	73,663	123,994c	895	168	78	33	2.3
New Haven	163,344	622,597	2,430	802	150	181	4.9
New London[2]	30,367	258,814a	613	92	45	24	3.0
Norwalk	49,458	451,813	765	421	52	34	8.5
Norwich	23,382	112,336	599	102	35	0	4.4
Stamford	73,584	681,812 a	755	174	78	46	2.4
Stratford	23,620	78,050	769	67	26	3	2.8
Torrington	27,770	27,429	286	52	24	19	1.9
Waterbury	104,242	231,061	1,707	284	117	95	2.7
West Hartford	44,401	59,380	581	40	36	6	0.9
West Haven Twp.	31,876	.....	.....	.....	.....	.....	.....
DELAWARE							
Wilmington	109,907	698,994	1,325	640	148	68	5.8
DISTRICT OF COLUMBIA							
Washington, D. C.	797,670	1,642,530	10,447	2,611	661	991	3.3
FLORIDA							
Daytona Beach	29,254	72,566	446	105	40	17	3.6
Fort Lauderdale	40,000	82,997c	524	107	45	25	2.7
Gainesville	26,577	23,115	281	142	29	34	5.3

a. Estimated. b. Incomplete. c. Building and contents only. e. Subject to change.
1. Fiscal year ended June 30, 1954. 2. Fiscal year ended September 30, 1954.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
FLORIDA (Continued)							
Jacksonville	198,800	560,348	.....	.....	.....	152	.....
Key West	21,724	.....	.....	.....	.....	.....	.....
Lakeland	30,846	95,487	400	179	34	16	5.8
Miami	246,983	564,674	2,942	602	175a	98	2.4
Miami Beach	45,541	37,232c	461	137	72	29	3.0
Orlando	51,826	165,487	605	80	50	51	1.5
Panama City	26,248	.....	.....	.....	.....	.....	.....
Pensacola	43,293	71,645	416	197	39	0	4.4
St. Petersburg	95,712	102,248c	1,290	299	82	7	3.1
Tallahassee	27,158	86,073	605	89	33	13	3.3
Tampa	124,073	597,584	2,675	627	156	168	5.1
West Palm Beach	43,053	163,975	360	44	10	19	1.0
GEORGIA							
Albany	30,987	.....	.....	.....	.....	.....	.....
Athens	20,102	102,380c	393	175	39	28	8.7
Atlanta	327,090	1,691,372	7,063	1,907	538	483	5.8
Augusta	71,507	343,962	1,070	502	116	46	7.0
Columbus	79,510	117,403c	853	370	77	67	4.7
Decatur	21,626	29,188	229	66	28	5	3.1
East Point	21,628	28,078	536	121	30	42	5.6
La Grange	24,954	118,800	456	108	57	12	4.3
Macon	70,106	206,343c	849	415	76	65	5.9
Marietta	20,628	45,658	414	110	39	45	5.3
Rome	29,617	78,007	389	108	42	20	3.7
Savannah	119,689	157,515	1,641	925	200	195	7.8
Valdosta	20,004	76,298c	510	184	34	9	9.2
IDAHO							
Boise	34,152	120,168c	520	118	23	24	3.5
Pocatello	25,882	264,575c	272	116	17	18	4.5
ILLINOIS							
Alton	32,176	122,350	437	259	46	5	8.0
Aurora	50,508	124,575	394	200	62	4	4.0
Belleville	32,701	.....	.....	.....	.....	.....	.....
Berwyn	51,176	80,330	610	111	17	6	2.2
Bloomington	34,048	160,090c	968	147	54	26	4.3
Champaign	39,397	88,027	290	164	38	11	4.2
Chicago	3,606,436	8,250,000	75,307	16,874	5,169	2,541	4.7
Chicago Heights	24,369	289,845c	181	98	22	25	3.4
Cicero	67,197	194,700	970	247	86	55	3.7
Danville	37,892	454,285	467	107	78	2	2.8
Decatur	67,803	.....	575	351	90	10	5.2
East St. Louis	81,950	292,824	1,110	469	109	112	5.7
Elgin	42,003	78,532c	431	81	30	18	1.9
Elmhurst	21,204	28,065c	146	32	9	5	1.5
Evanston	73,030	202,920	856	335	54	9	4.6
Freeport	22,425	53,322	236	29	27	23	1.3
Galesburg	31,357	43,958	256	63	28	2	2.0
Granite City	29,139	.....	.....	.....	.....	.....	.....
Harvey	20,636	50,412	395	69	45	25	3.3
Jacksonville	20,374	68,785	224	26	29	34	1.3
Joliet	52,460	187,397c	1,058	264	44	29	5.0
Kankakee	25,873	344,920	596	53	26	13	2.0
Maywood	27,409	70,095	223	86	17	13	3.1
Moline	37,296	57,230	328	138	34	59	3.7
Oak Park	63,175	53,885	1,094	242	48	8	3.8
Ottawa	22,000	14,315	241	112	40	4	5.1
Pekin	21,912	6,254,350	.....	.....	.....	4	.....

c. Building and contents only.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
ILLINOIS (Continued)							
Peoria	111,523	516,442	1,231	402	129	119	3.6
Quincy	41,402	69,405c	493	221	80	53	5.3
Rockford	92,503	204,598	1,015	414	115	17	4.5
Rock Island	48,594	225,877	490	137	40	25	2.8
Springfield	80,832	.....	.....	.....	.....	.....	.....
Urbana	22,995	215,290e	187	42	15	9	1.8
Waukegan	39,099	523,743	821	159	42	6	4.1
INDIANA							
Anderson	46,809	358,997	949	191	63	52	4.1
Bloomington	28,191	13,695	322	191	35	7	6.8
East Chicago	54,124	114,969c	1,267	232	58	97	4.3
Elkhart	35,556	146,535	625	289	36	29	8.1
Evansville	109,869	405,744	1,889	842	153	178	7.7
Fort Wayne	132,840	89,366	1,678	758	.....	110	5.7
Gary	132,496	382,842c	2,346	412	118	322	3.1
Hammond	87,423	55,413c	1,776	502	119	92	5.8
Indianapolis	424,683	536,228c	5,291	2,369	528	521	5.6
Kokomo	38,600	85,554c	519	218	58	49	5.6
Lafayette	35,508	68,333c	615	48	63	30	1.4
Logansport	20,933	23,570	379	208	37	33	9.9
Marion	30,059	101,295	504	285	62	41	9.5
Michigan City	28,379	36,123c	434	197	35	22	7.0
Mishawaka	32,878	257,988	356	140	39	34	4.3
Muncie	58,364	238,215c	896	399	89	55	6.9
New Albany	29,297	751,685	461	215	39	21	7.3
Richmond	39,504	43,140c	485	301	76	19	7.6
South Bend	115,698	459,975	1,502	714	134	115	6.2
Terre Haute	64.047	476,322	1,204	431	106	10	6.7
IOWA							
Ames	23,105	32,035	204	110	20	9	4.8
Burlington	30,639	62,261	455	108	42	4	3.5
Cedar Rapids	72,149	103,735	783	398	71	31	5.5
Clinton	30,151	18,483	350	181	42	9	6.0
Council Bluffs	45,184	422,826	607	176	61	33	3.9
Davenport	73,640	112,191	819	176	35	103	2.4
Des Moines	176,954	1,154,919	2,724	605	186	108	3.4
Dubuque	49,528	68,269	832	358	57	14	7.2
Fort Dodge	25,025	153,636	381	78	32	20	3.1
Iowa City	27,018	27,840	265	95	27	.....	3.5
Marshalltown	20,000	24,548	207	96	26	15	4.8
Mason City	27,593	133,095	414	78	35	1	2.8
Ottumwa	33,640	50,344c	343	202	39	1	6.0
Sioux City	84,035	448,796	903	390	76	55	4.6
Waterloo	64,354	315,404	801	348	74	63	5.4
KANSAS							
Hutchinson	33,524	118,089	634	200	59	19	6.0
Kansas City	129,583	845,744	1,669	548	190	59	4.2
Lawrence	23,292	148,140	301	.....	.....	10	.....
Leavenworth	20,543	174,743	318	99	10	5	4.8
Pittsburgh	25,134	39,260	482	125	43	5	5.0
Salina	26,141	85,877	546	185	39	7	7.1
Topeka	77,827	173,008c	958	341	107	53	4.4
Wichita	166,306	332,402	3,032	681	272	39	4.1

c. Building and contents only. e. Subject to change.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
KENTUCKY							
Ashland	31,228	.....	.....	.....	.....	.....	.....
Covington	64,282	46,200	709	206	63	57	3.2
Lexington	54,449	351,523	627	.....	83	91	.....
Louisville	367,359	2,057,877	4,358	2,179	526	204	5.9
Newport	31,015	4,320	360	165	88	35	5.3
Owensboro	33,983	118,397c	.....	.....	52	9	.....
Paducah	32,430	579,297	976	355	62	48	11.0
LOUISIANA							
Alexandria	34,685	173,745c	.....	348	.....	29	10.0
Baton Rouge	123,957	412,198	1,546	355	135	139	2.9
Lafayette	33,465	.....	.....	.....	.....	.....	.....
Lake Charles	41,202	.....	.....	.....	.....	.....	.....
Monroe	38,375	185,113c,e	1,073	198	56	34	5.2
New Orleans	567,257	1,255,534c	4,954	1,539	210	248	2.7
Shreveport	125,506	834,185	1,521	644	124	78	5.1
MAINE							
Auburn	23,078	69,000a	497	235	54	7	10.2
Augusta	20,900	25,816c	359	232	16	3	11.1
Bangor	31,473	254,000c	593	329	62	59	10.5
Biddeford	20,700	17,033	277	162	23	0	7.8
Lewiston	41,142	140,473	742	194	69	4	4.7
Portland	76,936	630,435a	1,469	159	90	87	2.1
South Portland	21,732	3,995	482	161	7	31	7.4
MARYLAND							
Baltimore	940,205	4,332,318c	14,209	3,736	1,026	1,045	4.0
Cumberland	37,632	.....	404	196	55	45	5.2
Hagerstown	36,232	262,941	444	264	56	20	7.3
Montgomery County	163,749	328,856	676	85	33	.....	0.5
MASSACHUSETTS							
Arlington	43,984	175,192b	858	61	55	35	1.4
Attleboro	23,665	38,809	588	84	23	17	3.5
Belmont	27,379	17,773c	617	173	33	36	6.3
Beverly	28,855	387,204	970	243	55	16	8.4
Boston	790,863	2,262,900a	15,137	3,785	789	2,152	4.8
Braintree	23,130	43,230	809	135	45	21	5.8
Brockton	62,856	322,495	1,675	460	80	90	7.3
Brookline	56,952	263,497	1,051	.....	125	62	.....
Cambridge	120,676	267,496	1,708	548	191	40	4.5
Chelsea	39,038	161,695	1,283	402	38	98	10.3
Chicopee	48,939	68,811	537	118	31	11	2.4
Everett	45,789	96,882c	1,034	171	45	83	3.7
Fall River	111,759	292,715	1,485	439	97	158	3.9
Fitchburg	42,671	67,143c	1,045	174	31	26	4.1
Framingham	27,845	.....	.....	.....	.....	.....	.....
Gloucester	25,048	650,000e	994	328	44	32	13.1
Haverhill	47,213	.....	.....	.....	.....	.....	.....
Holyoke	54,441	450,000a	1,020	413	197	53	7.6
Lawrence	80,427	352,976	1,799	273	73	72	3.4
Leominster	24,084	241,315	425	.....	.....	.....	.....
Lowell	96,523	.....	.....	.....	.....	.....	.....
Lynn	99,521	.....	2,634	639	118	207	6.4
Malden	59,779	298,012a	1,224	99	56	66	1.7
Medford	66,109	134,099b	1,340	170	86	91	2.6
Melrose	26,919	22,827	1,163	31	5	16	1.2

a. Estimated. b. Incomplete. c. Building and contents only. e. Subject to change.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
MASSACHUSETTS (Continued)							
Methuen	24,411	121,415	750	116	10	28	4.8
Milton	22,395	58,025c	628	87	40	29	3.9
New Bedford	109,033	210,570	1,440	283	76	91	2.6
Newton	80,996	160,683	1,925	.....	.....	57	.....
North Adams	21,475	76,669	389	158	60	23	7.3
Northampton	28,998	41,235	381	159	22	27	5.5
Peabody	22,647	170,588c	708	133	29	26	5.9
Pittsfield	53,055	278,273b	817	233	36	24	4.4
Quincy	83,190	287,175	2,197	370	111	113	4.5
Revere	36,663	156,690	997	89	11	122	2.4
Salem	41,842	71,086	830	189	67	8	4.5
Somerville	102,254	814,964	1,761	372	110	163	3.6
Springfield	162,601	.....	.....	.....	.....	.....	.....
Taunton	40,056	84,697	748	217	41	47	5.4
Waltham	47,198	.....	.....	.....	.....	.....	.....
Watertown	37,339	19,333c	888	98	26	47	2.6
Wellesley	20,847	31,779	612	35	33	7	1.7
Westfield	20,961	26,951	667	107	20	7	5.1
West Springfield	20,398	74,594	428	84	35	14	4.1
Weymouth	32.695	84,899a	978	87	63	18	2.7
Woburn	20.269	52,246	928	44	28	86	2.1
Worcester	201,885	.....	4,033	924	124	621	4.6
MICHIGAN							
Ann Arbor	47,279	256,040	455	277	55	4	5.9
Battle Creek	48,469	257,999	721	165	60	62	3.4
Bay City	52,372	92,215	697	289	53	14	5.5
Dearborn	94,529	484,343	1,024	201	81	137	2.1
Detroit	1,838,517	7,570,128a,e	16,534	5,349	1,541	2,184	2.9
East Detroit	21,373	50,163	276	113	27	4	5.3
East Lansing	20,310	43,617	190	15	10	7	0.7
Ferndale	29,670	78,600	359	93	25	0	3.1
Flint	162,800	501,327	.....	.....	.....	.....	.....
Grand Rapids	175,647	689,798	1,408	319	58	94	1.8
Hamtramck	43,245	71,627	571	282	31	75	6.5
Highland Park	46,155	243,229c	680	228	59	34	4.9
Jackson	50,904	540,316	587	216	48	77	4.2
Kalamazoo	51,326	120,645c	716	163	67	44	3.2
Lansing	91,694	351,576c	2,474	281	124	85	3.1
Lincoln Park	29,265	156,916	524	158	63	60	5.4
Monroe	21,275	226,352	282	126	25	27	5.9
Muskegon	48,047	461,240	503	274	53	65	5.7
Pontiac	73,112	508,133	1,409	354	68	69	4.8
Port Huron	35,297	89,244	465	170	43	10	4.8
River Rouge	20,366	60,600	218	109	26	25	5.3
Royal Oak	46,817	333,505	762	214	66	97	4.6
Saginaw	92,352	180,485a,c	1,588	279	95	44	3.0
Wyandotte	36,666	106,946	451	134	39	81	3.7
MINNESOTA							
Austin	23,035	25,136	186	106	18	15	4.6
Duluth	104,066	546,754	1,213	224	66	54	2.2
Minneapolis	517,277	2,263,381	4,505	1,094	340	301	2.1
Rochester	29.634	27,882	375	179	20	52	6.0
St. Cloud	22,744	51,767	259	.....	.....	2	.....
St. Louis Park	22,495	40,405	542	167	29	3	7.4
St. Paul	309,474	1,437,373	3,996	1,578	269	299	5.1
Winona	24.965	52,616	286	147	40	10	6.0

a. Estimated. b. Incomplete. c. Building and contents only. e. Subject to change

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
MISSISSIPPI							
Biloxi	37,034	.....	.....	.....	.....	.....	.....
Greenville	29,914	173,814c	547	93	42	27	3.1
Gulfport	22,428	.....	588	120	50	13	5.4
Hattiesburg	29,432	70,317c	591	118	38	17	4.0
Jackson	97,674	223,960	1,173	400	84	57	4.1
Laurel	24,988	68,247	448	140	28	19	5.6
Meridian	41,709	116,466	775	260	56	22	6.2
Natchez	22,678	.....	.....	.....	.....	.....	.....
Vicksburg	27,344	107,475	505	47	21	13	1.7
MISSOURI							
Cape Girardeau	21,539	94,699	304	134	28	14	6.2
Columbia	31,731	28,480	360	162	36	15	5.1
Hannibal	20,486	33,937	187	62	43	3	2.9
Independence	36,832	138,680	467	198	48	3	5.4
Jefferson City	24,990	108,974	319	79	28	9	3.2
Joplin	37,188	.....	743	254	106	24	6.8
Kansas City	439,646	2,510,502	5,258	1,949	612	414	4.4
St. Joseph	75,572	46,042	1,288	444	109	63	5.9
St. Louis	852,623	1,892,995	8,868	3,032	681	1079	3.6
Sedalia	20,269	36,804	273	128	32	1	6.3
Springfield	66,302	95,239a,c	1,231	338	99	38	5.1
University City	39,595	9,105	1,018	37	21	12	0.9
Webster Groves	23,289	21,600	323	75	17	2	3.2
MONTANA							
Billings	31,725	269,818c	481	67	26	34	2.1
Butte	32,904	804,674e	557	96	59	128	2.9
Great Falls	39,006	20,164a	461	129	49	159	3.3
Missoula	22,320	53,923	316	62	31	16	2.8
NEBRASKA							
Grand Island	22,835	68,515	219	103	21	.....	4.5
Hastings	20,108	211,337	283	84	23	6	4.2
Lincoln	97,423	292,123c	1,197	334	107	19	3.4
Omaha	247,408	1,945,987a	2,817	1,119	356	54	4.5
NEVADA							
Las Vegas	24,418	294,956c	853	216	104	27	8.9
Reno	32,225	172,169	1,054	303	88	5	9.4
NEW HAMPSHIRE							
Concord	27,984	51,525c	605	256	89	14	9.2
Manchester	82,581	523,000a	1,204	270	61	52	3.3
Nashua	34,666	91,674c	502	221	129	24	6.4
NEW JERSEY							
Atlantic City	61,642	.....	.....	.....	.....	.....	.....
Bayonne	76,657	.....	853	205	59	67	2.7
Belleville	32,059	144,704c	584	122	67	63	3.8
Bloomfield	49,313	266,399	745	238	53	20	4.8
Camden	125,546	689,801c	1,936	402	184	160	3.2
Clifton	64,567	174,096	892	102	76	61	1.6
East Orange	78,057	92,222b	794	251	65	58	3.2
Elizabeth	112,675	209,845c	1,217	330	139	68	2.9
Englewood	23,092	.....	454	197	39	85	8.6
Fair Lawn	23,865	.....	.....	.....	.....	.....	.....
Garfield	27,605	.....	.....	.....	.....	.....	.....
Hackensack	29,207	182,745c	625	92	28	22	3.1
Hillside	21,000	29,430	470	217	42	.....	10.3

a. Estimated. b. Incomplete. c. Building and contents only. e. Subject to change.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
NEW JERSEY (Continued)							
Hoboken	50,510	379,950c	970	282	77	65	5.6
Irvington	59,142	96,350	1,275	200	50	38	3.4
Jersey City	300,447	2,865,035	3,299	1,149	318	296	3.8
Kearny	39,828	26,935	459	51	57	38	1.3
Linden	30,434	72,835	618	179	85	32	5.9
Long Branch	23,094	275,000a	419	96	.....	12	4.2
Maplewood	25,000	33,364a	268	109	30	23	4.4
Montclair	43,775	63,962	586	.....	.....	18	.....
Newark	437,857	2,885,179	7,047	2,673	660	727	6.1
New Brunswick	38,768	241,732	544	158	48	24	4.1
North Bergen Twp.	39,714	247,300c	968	90	59	40	2.3
Nutley	26,746	12,713	439	82	27	21	3.1
Orange	38,413	399,461	559	344	53	42	9.0
Passaic	57,851	982,158	724	.....	43	45	.....
Paterson	139,423	421,251	1,688	914	163	89	6.6
Perth Amboy	41,291	617,429	331	107	72	18	2.6
Plainfield	42,212	.....	600	163	46	29	3.9
Rahway	21,287	29,663	368	96	21	14	4.5
Teaneck Twp.	34,000	70,906	742	124	37	7	3.6
Trenton	127,867	594,906	1,363	460	135	147	3.6
Union City	55,322	205,843c	909	237	51	35	4.3
Union Twp.	39,000	356,247	617	182	58	0	4.7
West New York	37,754	655,736c	597	111	20	27	2.9
Westfield	21,335	.....	938	89	25	8	4.2
West Orange	28,624	31,370a	444	147	42	11	5.1
NEW MEXICO							
Albuquerque	97,000	.....	.....	.....	.....	.....	.....
Roswell	25,572	52,167	286	180	35	2	7.1
Santa Fe	29,750	6,440	153	36	19	7	1.2
NEW YORK							
Albany	134,382	249,394c	3,468	513	115	226	3.8
Amsterdam	32,269	80,274	307	136	16	19	4.2
Auburn	36,667	71,210	350	139	21	18	3.8
Binghamton	81,132	463,129	752	163	49	17	2.0
Buffalo	477,393	2,385,694	3,410	1,094	289	300	2.3
Cohoes	21,235	14,993	316	49	17	9	2.3
Elmira	49,690	97,501c	536	146	45	30	2.9
Endicott	20,168	10,106	171	59	18	6	2.9
Freeport	24,589	.....	.....	.....	.....	.....	.....
Gloversville	23,576	164,579c	267	52	16	20	2.2
Hempstead	29,021	45,816	409	104	46	23	3.6
Irondiquoit Twp.	34,045	.....	.....	.....	.....	.....	.....
Ithaca	29,395	205,686c	240	142	35	6	4.8
Jamestown	43,250	126,185c	517	151	57	21	3.5
Kenmore	20,332	32,087	100	31	13	3	1.5
Kingston	28,860	33,928c	467	179	35	13	6.2
Lackawanna	27,646	77,625	363	57	29	48	2.1
Lockport	25,136	346,120	410	123	52	24	4.9
Middletown	22,565	13,168	319	94	26	6	4.2
Mount Vernon	71,837	525,818c	1,061	279	.....	59	3.9
Newburgh	31,924	219,227	312	131	54	25	4.1
New Rochelle	59,626	269,549	729	269	51	37	4.5
New York	7,835,099	25,288,700c	75,361	23,405	5,234	12,853	3.0
Niagara Falls	90,875	197,878	1,259	326	86	113	3.6
North Tonawanda	24,730	27,565	327	76	14	20	3.1
Olean	22,842	126,610	203	42	16	5	1.8
Oswego	22,611	45,720c	301	97	.....	9	4.3

a. Estimated.

c. Building and contents only.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
NEW YORK (Continued)							
Port Chester	23,969	302,700	298	122	30	5	5.1
Poughkeepsie	40,975	320,018	432	208	69	17	5.1
Rochester	331,252	1,231,591	3,469	871	164	237	2.6
Rockville Centre	22,274	169,558	148	45	15	22	2.0
Rome	41,379	.....	.....	.....	.....	.....	.....
Schenectady	92,070	190,120	1,035	249	74	119	2.7
Syracuse	220,067	773,974	1,695	659	204	199	3.0
Troy	71,659	198,732c	1,327	528	67	30	7.4
Utica	101,479	359,471	897	257	76	34	2.5
Valley Stream	26,833	.....	.....	.....	.....	.....	.....
Watertown	34,280	60,551	361	127	24	30	3.7
White Plains	43,501	183,343c	613	210	65	33	4.8
Yonkers	152,533	623,627a	2,288	605	131	111	4.0
NORTH CAROLINA							
Asheville	52,208	167,421c	750	59	40	77	1.1
Burlington	24,495	82,836	527	101	39	21	4.1
Charlotte	133,219	402,496b,e	2,758	765	165	456	5.7
Durham	70,307	175,179c	877	478	85	58	6.8
Fayetteville	34,605	75,861	811	278	63	70	8.0
Gastonia	23,003	40,505c	446	154	36	28	6.7
Goldsboro	21,399	269,551a,e	682	238	39	19	10.6
Greensboro	73,703	327,580c	1,066	447	100	88	6.1
High Point	39,930	1,151,340c	730	358	41	36	9.0
Raleigh	65,123	237,748	982	436	103	115	6.7
Rocky Mount	27,644	40,395c	397	108	34	17	3.9
Wilmington	44,925	157,428c	603	326	40	86	7.3
Wilson	22,964	37,835c	362	177	30	21	7.7
Winston-Salem	86,816	439,521	1,312	168	88	69	1.9
NORTH DAKOTA							
Fargo	37,981	654,741	647	171	98	16	4.5
Grand Forks	26,617	34,226	204	127	16	13	4.8
Minot	21,924	44,664	251	41	21	6	1.9
OHIO							
Akron	273,189	641,535	2,308	605	221	292	2.2
Alliance	26,112	44,325	243	58	18	6	2.2
Ashtabula	23,093	208,733	308	94	24	5	4.1
Barberton	27,893	352,923	313	68	29	38	2.4
Canton	116,312	446,887c	965	233	87	107	2.0
Chillicothe	20,121	27,612	433	163	38	10	8.1
Cincinnati	500,510	794,890	5,355	1,867	549	350	3.7
Cleveland	905,636	2,712,250	9,365	2,312	627	841	2.6
Cleveland Heights	58,782	46,125	994	212	38	17	3.6
Columbus	374,770	1,312,333	13,023	2,305	524	200	6.2
Cuyahoga Falls	29,076	103,095c	390	123	31	37	4.2
Dayton	243,108	551,365	3,321	607	236	246	2.5
East Cleveland	39,875	36,128	519	74	22	26	1.9
East Liverpool	24,072	85,329c	463	107	37	8	4.5
Elyria	30,197	57,445	301	45	19	5	1.5
Euclid	41,447	45,281	528	150	40	13	3.6
Findlay	23,806	26,595	282	110	31	3	4.6
Garfield Heights	21,606	36,690	192	33	15	7	1.5
Hamilton	57,717	149,770	1,307	286	78	56	5.0
Lakewood	67,878	32,340	272	75	27	35	1.1
Lancaster	24,140	64,039	1,041	117	50	11	4.9
Lima	49,880	238,507	536	266	59	20	5.3
Lorain	50,819	53,710	554	96	43	42	1.9

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City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
OHIO (Continued)							
Mansfield	43,363	97,515	574	229	92	20	5.3
Marion	33,786	71,288	456	141	45	15	4.2
Massillon	29,524	104,481c	.....	.....	.....	20	.....
Middletown	33,634	58,392	513	163	36	53	4.9
Newark	34,178	55,299	712	27	72	25	0.8
Norwood	34,626	44,989	250	162	32	13	4.7
Parma	28,852	28,421	772	56	22	15	1.9
Portsmouth	36,663	38,541	474	167	96	32	4.6
Sandusky	29,060	134,962	669	141	27	4	4.9
Shaker Heights	27,980	94,603	888	206	37	12	7.4
Springfield	78,029	255,291	936	423	81	72	5.4
Steubenville	35,695	44,845c	357	73	40	41	2.0
Toledo	301,358	408,382	2,390	898	287	231	3.0
Warren	49,674	118,979	536	89	78	39	1.8
Youngstown	167,643	1,187,635	1,389	340	131	142	2.0
Zanesville	40,424	231,933c	386	176	52	60	4.4
OKLAHOMA							
Enid	35,976	207,668c	539	193	.....	17	5.4
Lawton	34,527	268,703	834	278	60	2	8.1
Muskogee	37,255	108,043c	778	142	84	33	3.8
Norman	26,972	16,302	185	68	23	0	2.5
Oklahoma City	242,450	1,161,790	5,550	1,260	267	117	5.2
Ponca City	20,185	99,244	438	127	42	11	6.3
Shawnee	24,457	.....	377	50	37	35	2.0
Stillwater	20,155	48,135	347	86	33	6	4.3
Tulsa	180,586	643,265	3,142	821	193	168	4.6
OREGON							
Eugene	35,672	210,631	459	72	29	14	2.0
Portland[1]	371,011	1,901,770c	4,685	3,061	259	293	8.3
Salem	43,064	133,255	426	302	6	16	7.0
PENNSYLVANIA							
Aliquippa	26,067	118,020	173	67	8	19	2.6
Allentown	106,233	81,504	477	208	57	27	2.0
Altoona	76,844	72,230	692	371	57	82	4.8
Bethlehem	66,027	.....	.....	.....	.....	.....	.....
Butler	23,511	35,320	353	154	54	5	6.6
Cheltenham Twp.	23,000	.....	.....	.....	.....	.....	.....
Chester	65,824	151,864	793	230	50	52	3.5
Dunmore	20,302	.....	.....	.....	.....	.....	.....
Easton	34,410	28,496	227	101	37	13	2.9
Erie	130,125	.....	.....	.....	.....	.....	.....
Harrisburg	89,091	250,000e	572	374	69	27	4.2
Haverford Twp.	40,000	113,504	404	73	13	17	1.8
Hazleton	35,486	.....	.....	.....	.....	.....	.....
Johnstown	62,723	36,228	749	260	36	38	4.1
Kingston	21,061	31,000	152	11	20	5	0.5
Lancaster	63,601	228,313c	345	250	37	31	3.9
Lebanon	28,134	.....	.....	.....	.....	.....	.....
Lower Merion Twp.	49,000	275,718	711	173	58	2	3.5
McKeesport	51,223	218,025	587	227	32	107	4.4
Mount Lebanon Twp.	26,604	22,220c	217	63	12	.....	2.4
Nanticoke	20,140	9,620	65	12	7	7	0.6
New Castle	48,563	152,892c	464	243	20	37	5.0
New Kensington	25,226	131,345c	93	44	.....	14	1.7
Norristown	38,143	82,521	178	124	12	6	3.3
Philadelphia	2,064,794	8,721,554c	28,736	7,008	1,831	2,845	3.4

c. Building and contents only. e. Subject to change. 1. Fiscal year ended June 30, 1954.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
PENNSYLVANIA (Continued)							
Pittsburgh	673,763	1,500,000a	4,795	2,324	526	948	3.5
Pottstown	22,616	196,060c	179	45	16	5	2.0
Pottsville	23,642	39,610	134	46	10	3	2.0
Reading	109,062	275,872c	2,949	1,446	11	57	13.2
Scranton	124,305	620,000c	1,031	331	102	96	2.7
Sharon	26,305	104,401c	296	80	60	9	3.0
Uniontown	20,423	46,955c	223	5	25	9	0.3
Upper Darby Twp.	186,000	.....	.....	.....	.....	.....	.....
Washington	25,898	28,956	183	89	38	12	3.4
Wilkes-Barre	76,638	861,248	603	213	43	46	2.8
Wilkinsburg	31,281	27,450	164	57	21	44	1.8
Williamsport	44,946	61,148c	373	149	24	6	3.3
York	59,704	127,369c	314	188	41	38	3.2
RHODE ISLAND							
Central Falls	23,610	42,361	299	86	27	9	3.6
Cranston	55,130	92,046c	1,341	176	52	52	3.2
East Providence	35,791	31,204	912	122	36	56	3.4
Newport	32,090	54,567	446	194	87	19	6.1
Pawtucket	81,180	625,914	1,342	70	75	157	0.9
Providence	274,700	650,216c	5,303	354	358	419	1.3
Warwick Twp.	43,027	.....	.....	.....	.....	.....	.....
Woonsocket	50,186	.....	.....	.....	.....	.....	.....
SOUTH CAROLINA							
Charleston	68,243	158,791c	1,076	461	52	188	6.8
Columbia	85,949	334,664c,e	1,210	611	156	64	7.1
Greenville	57,932	189,533	1,033	426	83	87	7.4
Spartanburg	36,674	103,536	613	115	50	83	3.1
SOUTH DAKOTA							
Rapid City	25,179	365,257	413	69	15	0	2.8
Sioux Falls	52,161	251,515a	469	140	42	9	2.7
TENNESSEE							
Chattanooga	130,333	407,644	2,496	776	140	310	6.0
Jackson	30,098	397,042	510	249	23	10	8.3
Johnson City	27,778	60,538	503	159	42	9	5.7
Knoxville	124,183	380,714c	2,199	741	149	121	6.0
Memphis	394,012	1,491,915	6,332	2,196	435	137	5.6
Nashville	173,359	1,475,724c	4,064	1,064	212	262	6.1
TEXAS							
Abilene	47,102	190,000c	764	250	73	29	5.3
Amarillo	73,737	484,699c	1,157	214	14	86	2.9
Austin	131,964	320,492c	1,923	365	172	20	2.8
Baytown	22,927	37,163c	209	84	14	4	3.7
Beaumont	93,715	157,197	1,326	510	37	50	5.4
Brownsville	36,176	29,533b	261	79	18	18	2.2
Brownwood	20,140	51,217	.....	.....	185	312	.....
Corpus Christi	108,053	443,614c	1,164	358	115	85	3.3
Dallas	432,927	2,857,067	8,130	1,328	671	202	3.1
Denton	21,345	43,000c	356	113	31	3	5.3
El Paso	130,000	232,669c	1,551	477	151	146	3.7
Fort Worth	277,047	1,310,706c	5,080	1,428	411	268	5.2
Galveston	65,898	242,926c	.....	80	190	.....	1.2
Harlingen	23,202	.....	.....	.....	.....	.....	.....
Houston	594,321	3,066,792a,c	7,523	2,544	500	787	4.3
Laredo	51,694	20,163	348	103	26	34	2.0

a. Estimated. b. Incomplete. c. Building and contents only. e. Subject to change.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
TEXAS (Continued)							
Longview	24,445	87,840c	.....	.....	.....	.....	.....
Lubbock	71,390	218,000a	947	366	73	30	5.1
Marshall	22,255	162,000a,c	539	63	36	5	2.8
McAllen	20,005	72,668c	126	32	16	23	.....
Midland	21,756	274,101c	354	219	62	.....	10.1
Odessa	29,432	166,883c	440	225	62	48	7.7
Orange	21,100	36,000c,e	342	93	37	33	4.4
Paris	21,636	80,310c	496	149	39	4	6.9
Pasadena	22,444	125,873	252	84	14	3	3.8
Port Arthur	57,377	70,230c	488	109	40	61	1.9
San Angelo	51,889	151,649c	635	210	64	44	4.1
San Antonio	406,811	72,601	485	173	34	26	0.4
Sherman	20,013	.....	.....	.....	.....	.....	.....
Temple	24,970	118,438c	361	48	49	12	1.9
Texarkana	24,657	.....	.....	.....	.....	.....	.....
Tyler	38,864	125,964	770	170	52	65	4.4
University Park	23,823	93,567c	198	35	15	2	1.5
Waco	84,300	.....	.....	.....	.....	.....	.....
Wichita Falls	67,709	1,000,548	1,434	428	91	89	6.3
UTAH							
Ogden	56,910	106,725	1,100	222	47	39	3.9
Provo City	28,901	422,437	280	75	16	13	2.6
Salt Lake City	181,718	242,450	2,041	648	125	104	3.6
VERMONT							
Burlington	33,039	.....	531	267	61	34	8.1
VIRGINIA							
Alexandria	61,604	120,523c	901	336	72	8	5.5
Arlington County	134,990	256,767	1,799	500	151	36	3.7
Charlottesville	25,909	357,868c	459	134	48	10	5.2
Danville	34,537	81,845	521	232	59	24	6.7
Hampton	60,994	221,729	878	321	34	83	5.3
Lynchburg	47,639	111,940	908	323	66	86	6.8
Newport News	41,571	246,886	797	336	36	92	8.1
Norfolk	188,601	779,065	3,729	987	163	451	5.3
Petersburg	34,948	25,442	915	358	69	71	10.3
Portsmouth	71,294	567,585	1,335	328	64	91	4.6
Richmond	229,906	304,590	3,625	2,236	389	210	9.8
Roanoke	91,089	120,666	1,243	345	78	114	3.8
Warwick	39,875	34,525	638	122	38	15	3.1
WASHINGTON							
Bellingham	33,934	.....	.....	.....	.....	.....	.....
Bremerton	27,746	17,637	376	260	34	28	9.4
Everett	33,807	70,004c	719	128	36	38	3.8
Longview	20,556	13,116	.....	.....	.....	27	.....
Seattle	462,985	1,028,634c	5,206	978	343	265	2.1
Spokane	160,484	412,251c	2,047	1,223	133	159	7.6
Tacoma	142,975	459,747c	2,138	1,151	111	145	8.1
Vancouver	27,977	215,802c	541	372	31	25	13.3
Walla Walla	24,071	44,039c	399	124	60	22	5.2
Yakima	38,375	52,435	604	299	53	24	7.8
WEST VIRGINIA							
Bluefield	21,341	.....	.....	.....	.....	.....	.....
Charleston	72,818	228,610	797	238	73	145	3.3
Clarksburg	31,817	8,503c	220	125	24	9	3.9
Fairmont	29,273	19,850a,c	731	120	23	5	4.1

a. Estimated. c. Building and contents only. e. Subject to change.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
WEST VIRGINIA (Continued)							
Huntington	86,160	379,350c	1,254	476	104	115	5.5
Morgantown	25,443	9,115c	288	71	20	5	2.8
Parkersburg	10,492	368,498c	332	110	42	13	2.7
Weirton	24,143	33,677	181	54	22	3	2.2
Wheeling	58,447	56,609	1,769	201	55	19	3.4
WISCONSIN							
Appleton	33,892	114,749	543	308	28	34	9.1
Beloit	29,541	52,425	450	.....	.....	.....	.....
Eau Claire	35,862	57,855	507	177	37	35	4.9
Fond du Lac	29,826	69,672	307	166	41	17	5.6
Green Bay	52,443	149,851	800	295	41	63	5.6
Janesville	24,829	113,512	502	194	30	27	7.8
Kenosha	54,360	211,984	893	235	49	11	4.3
La Crosse	47,396	136,109	739	301	62	23	6.3
Madison	95,594	138,727	842	282	71	37	2.9
Manitowoc	27,444	40,462	352	104	24	16	3.8
Milwaukee	632,651	1,994,459	9,060	1,443	383	340	2.3
Oshkosh	40,934	76,103	570	241	25	20	5.9
Racine	70,749	157,100	1,796	208	50	36	2.9
Sheboygan	42,485	33,311	400	311	56	10	7.3
Superior	35,091	208,278	546	259	31	24	7.4
Waukesha	21,186	.....	.....	.....	.....	.....	.....
Wausau	30,386	36,270	470	111	20	15	3.7
Wauwatosa	33,300	39,519	606	174	26	8	5.2
West Allis	42,945	94,030	780	137	39	20	3.2
WYOMING							
Casper	33,557	118,528	264	101	26	6	3.0
Cheyenne	31,807	154,533	325	107	25	27	3.4

1954 FIRE LOSSES, CANADIAN CITIES

ALBERTA							
Calgary	135,000	1,596,601	1,265	443	126	199	3.3
Edmonton	158,912	643,116c	1,403	809	10	214	5.1
Lethbridge	23,000	20,642	236	80	22	10	3.5
BRITISH COLUMBIA							
Burnaby	60,000	114,861	801	329	32	1	5.5
New Westminster	30,000	1,197,969	402	66	38	15	2.2
Saanich	24,000	26,584	500	196	23	0	8.2
Vancouver	385,500	1,056,932	5,193	2,479	147	96	6.4
Victoria	50,774	500,248	793	467	22	88	9.2
MANITOBA							
Brandon	21,214	11,050	297	42	11	30	2.0
St. Boniface	26,214	67,852	375	195	8	49	7.5
Winnipeg	229,045	.....	.....	.....	.....	.....	.....
NEW BRUNSWICK							
Moncton	30,000	103,732	425	261	14	42	8.7
Saint John	63,000	440,400a	1,296	435	40	92	6.9
NOVA SCOTIA							
Glace Bay	28,000	56,306c	129	104	4	6	3.7
Halifax	122,656	506,338	1,728	892	60	106	7.3
Sydney	28,305	.....	.....	.....	.....	.....	.....

a. Estimated.

c. Building and contents only.

City	Population (Last Census)	Total Loss 1954	No. Alarms 1954	No. Bldg. Fires 1954	No. Auto Fires 1954	No. Malicious False Alarms 1954	Bldg. Fires Per 1000 Population
ONTARIO							
Brantford	36,602	70,947	487	143	27	1	3.9
Chatham	22,000	15,576c	167	98	21	12	4.5
East York Twp.	67,000	42,750	246	46	32	11	0.7
Etobicoke	46,000	338,245c	557	340	40	14	7.4
Fort William	30,585	.....	.....	.....	.....	.....	.....
Galt	23,085	70,585c	245	121	11	27	5.3
Guelph	25,962	29,263	468	.....	.....	.....	.....
Hamilton	196,246	830,137	2,300	582	118	164	3.0
Kingston	36,000	755,595	683	439	27	52	12.2
Kitchener	43,084	35,020	418	309	15	2	7.2
London	94,027	218,703c	883	234	.....	33	2.5
Niagara Falls	20,589	20,900	224	88	31	15	4.3
North York Twp.	62,646	173,922	874	326	73	34	5.2
Oshawa	40,727	75,933	450	218	43	15	5.4
Ottawa	220,026	974,176	2,144	1,328	137	34	6.0
Peterboro	35,065	.....	.....	.....	.....	.....	.....
Port Arthur	32,000	69,626	490	227	10	56	7.1
St. Catharines	37,988	161,526c	440	217	31	12	5.7
Sarnia	35,000	116,030c	330	118	24	7	3.4
Sault Ste. Marie	33,000	56,443c	473	271	32	25	8.2
Scarboro Twp.	60,000	176,980	805	116	50	69	1.9
Sudbury	50,222	355,495c	405	94	22	2	1.9
Timmins	26,385	91,965	521	73	15	12	2.8
Toronto	666,467	2,540,870a,c	6,708	2,739	569	792	4.1
Windsor	121,011	350,000	1,288	538	100	151	4.4
York Twp.	98,000	573,665	701	469	42	29	4.8
QUEBEC							
Chicoutimi	21,337	170,416d	246	.....	12	22	.....
Hull	43,871	55,424	786	11	39	118	0.3
Jonquiere	25,765	34,000	430	316	9	66	12.3
Lachine	29,625	12,872	200	52	15	50	1.8
Montreal	1,181,955	5,920,196	11,296	1,472	463	3,150	1.2
Outremont	32,000	235,309	216	.....	.....	.....	.....
Quebec	205,115	1,059,395	2,341	975	84	569	4.8
Shawinigan Falls	38,000	35,000	252	5	15	17	0.1
Sherbrooke	52,000	222,742c	731	413	40	66	7.9
Three Rivers	53,000	.....	.....	.....	.....	.....	.....
Verdun	79,050	48,354	669	470	19	80	5.9
Westmount	27,203	46,834c	307	64	18	40	2.4
SASKATCHEWAN							
Moose Jaw	25,000	114,093	394	3	19	30	0.1
Regina	69,995	623,354	917	97	36	125	1.4
Saskatoon	53,000	115,459c	1,180	373	31	81	7.0

a. Estimated. c. Building and contents only. d. Insured loss only.

Fire Protection For Chemicals – Part 4*

By Charles W. Bahme

EDITOR'S NOTE: The following article is the fourth installment of a manuscript prepared by Mr. Bahme for class instruction in fire protection engineering and for the training of members of the fire service charged with responsibility of safeguarding life and property against the fire and explosion hazards of dangerous chemicals. It should also be valuable reference material for the industries concerned with the manufacture, storage and transportation of chemicals, fire prevention authorities and others concerned with life and property safety.

Rather than delay publication until the manuscript could be published as a unit, the NFPA is making the information available by serial publication in the *Quarterly*. Readers are invited to submit their comments to the NFPA Executive Office.

The recommendations in this article are those of the author and do not necessarily reflect the official recommendations of the National Fire Protection Association, the U. S. Navy or the Los Angeles Fire Department.

Data on General Classes of Chemicals (Continued)

Electroplating Chemicals

The process of electroplating consists of electrically depositing a film of metal on an object. Both metallic and non-metallic substances can be electroplated and the reason for doing so may be to provide a corrosion resistant surface or merely for decorative purposes.

Electroplating is usually accomplished by placing two conducting bars in a tank containing the plating solution. The bars are insulated from the tank and from each other. The article to be plated is hung from the negative (cathode) bar, while the positive bar (anode) is usually of the metal to be deposited.

Thus the metal which is deposited is usually dissolved from the anode, and by the flow of current from the anode (positive) is carried over and deposited on the cathode (or negative object to be plated). However, the arrangement may be such that the metal plated is obtained from a dissolved salt in the plating solution.

Charles W. Bahme, member of the NFPA Committee on Hazardous Chemicals and Explosives, has had more than 17 years of varied experience in the Los Angeles Fire Department, having been a fire fighter, fire inspector, arson investigator and head of its Public Relations Bureau. He is presently a Battalion Chief in the fire fighting force of the Los Angeles Fire Department. He is an attorney, having membership in the California State Bar Association. At the time of Mr. Bahme's recall to active duty by the Navy, he headed the Dangerous Chemicals and Explosives Detail of the Los Angeles Fire Department in which capacity he drafted the "Dangerous Chemicals Code" for the city of Los Angeles. Part of Mr. Bahme's service in the U. S. Navy was spent on active duty in the Office of the Chief of Naval Operations, in the capacity of Security Coordinator for the Navy.

*Part 1 was published in the April 1952 *Quarterly*, pp. 323-346. Part 2 was published in the April 1953 *Quarterly*, pp. 332-353; Part 3 was published in the July 1953, *Quarterly*, pp. 86-97.

Constituents of Plating Baths

Plating solutions or baths may include all or part of the following constituents:

(1) Salt of the metal to be deposited.
(2) An additional salt to increase the conductivity of the bath.
(3) A material to cause anode corrosion.
(4) An agent to effect the type of deposit produced.
(5) A buffer material to maintain the proper acidity of the solution.

For example, an ordinary nickel plating solution will have the metal in the form of nickel sulfate ($NiSO_4$-$7H_2O$), 105 grams per liter; ammonium chloride (NH_4Cl) or ammonium sulfate ($[NH_4]_2$-SO_4), 15 grams per liter, to increase the conductivity of the bath; nickel chloride ($NiCl_2 6H_2O$), 15 grams per liter to assist anode corrosion, and boric acid (H_3BO_3), 15 grams per liter, which acts as a buffer to maintain the acidity of the solution at a pH of 5.3.

During the course of plating an article, careful rinsing is performed to prevent any "carry-over" of acid into a cyanide bath (or vice versa), with resultant formation of deadly hydrocyanic acid (HCN). One case is reported of a fatal accident that involved an operator who, by mistake, poured a carboy of sulfuric acid into a cyanide bath.

Plating Bath Currents

The amount of electrical current used depends upon several factors, such as the decomposition voltage of the metallic salt, the resistance offered by the solution, the type of metal being plated, and the area of the cathode.

Generally the terminal voltage of a plating tank is low, and generators are designed to put out from 6 to 12 volt high-amperage current. Current densities may vary from one ampere per square foot for platinum to 300 for chromium; in the latter case, a cathode of ten square feet surface area would require about 3,000 amperes. Only direct current is used.

As a general rule, metals which readily alloy with one another form good bonds, otherwise an intermediate plating may be necessary. It is generally the practice, for example, in arriving at a chrome finish on steel, to first give it a "flash" coat of copper, followed by nickel plate, and then the chrome plate.

To prevent excessive hydrogen evolution during plating, care should be taken to avoid excessively high current densities, potentials and operating temperatures. Under conditions that produce a high quality plated surface, hydrogen is given off at a slow rate and can be safely and easily exhausted to outdoors.

Table 10
Typical Electroplating Current Densities

Metal	Bath Type	Anode	Cathode Current Density (Amperes per sq. ft.)	Temp. °C.
Copper	Acid sulfate	Cu	15-40	25-50
	Alkaline cyanide	Cu	3-14	35-40
Nickel	Single sulfate	Ni	5-20	20-30
	Double sulfate	Ni	3-16	20-30
	Sulfate-chloride	Ni	14-50	50-60
Chromium	Chromic acid	Pb	100-300	40-50

Chemical and Electrolytic Cleaning

Since electroplating does not cover up any of the imperfections in the object to be plated (the bumps will still be there), the preparation of the object for plating is very important. Thorough cleaning is necessary, and the use of chlorinated compounds for degreasing, such as trichlorethylene, or perchlorethylene, is quite common for iron and steel.

People are sometimes overcome or given a sort of "jag" by the use of chlorinated solvents, such as perchlorethylene and trichlorethylene. Moreover, the vapors of the latter (which is used above its boiling point of 188°F) are combustible when mixed with the proper amount of air and have resulted in explosions when ignited, e.g., by welding operations while the tank was in operation, or by other sources of ignition.

The principal causes of fires and explosions at trichlorethylene vapor degreasers have been due either to decomposition of the solvent by aluminum fines, or to overheating of the residue of cutting oils or other flammable liquids that remained when the solvent was accidentally removed by evaporation. Automatic temperature controls should be provided to prevent overheating. (See **Chlorinated Hydrocarbons** for fire and health hazards of these degreasing agents.)*

Non-ferrous articles are ordinarily pickled in bright dips consisting of mixtures of sulfuric and nitric acids with the addition of small amounts of salt. Electrolytic cleaning is quicker than ordinary chemical pickling, and employs current densities of at least 10 amperes per sq. ft. on the cathode, at which point a vigorous evolution of hydrogen occurs, particularly in strong caustic solutions. The principle is just the reverse of electroplating, since the current is made to flow in the opposite direction. The cleaning is rapid owing to the formation of free alkali at the cathode and due to the action of the hydrogen formed on the metal in "kicking off" the scale, grease, etc., as it is released. According to reports, if the metallic object to be cleaned is accidentally "shorted" against the side of the tank, the resulting arc will frequently ignite the hydrogen over the tank. One expert stated, "In many plants alkaline cleaner tanks are not ventilated and, in many cases where so-called 'heavy-duty' cleaners are used at high current densities, a mixture of hydrogen, oxygen and steam accumulates above the solution in such quantities that frequently violent explosions occur, splashing the hot alkali over the hands and faces of employees. This could be prevented by proper installation of suction ducts."

In Los Angeles, 17 persons were killed by an explosion of a perchloric acid-acetic anhydride solution being used to polish aluminum fountain pen caps electrolytically.* One of the largest manufacturers of aluminum products states that it has long recognized the hazards involved in using perchloric acid† and has carefully avoided its use in finishing aluminum.

Typical Electroplating Procedure

The steps that would be followed to electroplate a corroded automobile bumper are presented as an example of typical electroplating procedure.

*See first installment of *"Fire Protection for Chemicals,"* published in the April, 1952 NFPA QUARTERLY.

*For a report of the explosion see April 1947 NFPA QUARTERLY, p. 275.

†The hazardous properties of perchloric acid are discussed under Per-acids, to be included in a future installment of this article.

The bumper is:

1. Cleaned in caustic solution to remove dirt, oil, oxides, etc.

2. Washed in tank of running water to neutralize and remove cleaning residues (sometimes an acid solution is used).

3. Suspended in reverse "strip" tank on the positive bar and subjected to about 10 amperes current density in an acid solution.

4. Washed in running water, and dried with air or sawdust.

5. Buffed with various rouges.

6. If discolored by the buffing operation, the stain is removed by a hydrochloric acid solution, which is then washed off in running water.

7. Placed in "strike tank" to give a flash undercoating of copper. (If a cyanide solution is used, it contains about 3 oz.

Table 11

Special Hazards in Electroplating Plants

Hazards	Measures to Avert
1. Hazardous chemical storage: acids, caustics, cyanides, flammable liquids, chromic acid, chlorinated hydrocarbons, etc.,*	
a. Incorrect location in city	Refer to zoning officials
b. Incorrect type of room or building for chemicals	Sprinkler, conform or move out
c. Quantity too large	Cut down amounts, store outside, or provide fire-resistive room
d. Improper segregation	Separate incompatibles
2. Spills causing burns and fumes	Neutralize, flush, absorb
3. Tank rupture causing mixing of acids and cyanides to form HCN	Install drains, dikes, flushing systems, neutralizing pits
4. Electric generators (bus bars not hazardous to life)	Insulate, isolate
5. Gas flames left under hot tanks	Insulate, separate; ventilate gas fumes. Provide automatic temperature controls for degreasing baths
6. Glycerine in stripper causing flammable vapor	Ventilate; shut off current
7. Flammable and toxic vapors at degreasing baths	Ventilate, separate. Keep gas shut-offs well away from tank. Provide automatic temperature controls for degreasing baths
8. Sawdust on floor, in nitric or chromic acid, or near flame	Practice good housekeeping; use only noncombustible materials to absorb nitric or chromic acid solutions
9. Hydrogen from electrolyzed solutions	Ventilate
10. Toxic fumes from chrome tanks	Prevent bubbling; ventilate
11. Flammable dusts from buffing	Provide dust collection system

*In the 149 electroplating plants surveyed recently in the city of Los Angeles, it was found that a total of 153 different chemicals were in use (not all in any one plant, however). There was an average in each plant of about 162 gallons of acids in carboys, 241 lbs. of solid chromic acid (and odd amounts of other oxidizers), 34 lbs. of flammable solids, 1,500 lbs. of solid caustics, 200 lbs. of cyanides, and 49 gallons of flammable liquids with a flash point under 100°F.

of copper cyanide ($Cu[CN]_2$) per gal., 4 oz. per gal. of sodium cyanide (NaCN) and 2 oz. per gal. of sodium carbonate (Na_2CO_3). The temperature of the bath is approximately 120°F and the current density at the cathode is about 3 amperes per sq. ft.

8. Then rinsed with water (and may receive a buffing).

9. Nickel-plated in a solution containing about 32 oz. per gal. of nickel sulfate ($NiSO_4$-$7H_2O$), 2 oz. per gal. of nickel chloride ($NiCl_2$-$6H_2O$), and 4 oz. per gal. of boric acid (H_3BO_3). Temperature of the bath is between 120°F and 130°F and the current density at the cathode is 2 to 4 amperes per sq. ft.

10. Rinsed again, cleaned (acid dip and alkaline cleaner plus rinses may precede the next step; sometimes a buffing).

11. Chrome plated in a bath containing about 33 oz. per gal. of chromic anhydride (CrO_3) and 0.34 oz. per gal. of sulfuric acid (H_2SO_4). The temperature of the bath is 113°F, and the current density at the cathode is between 150 and 200 amperes per sq. ft.

12. Washed, dried and sent to buffing room for final polish.

Table 12

Special Hazards During Fires in Electroplating Plants

Danger	Cause	Protective Measures
1. Tissue destruction (Acids and Caustics)	Broken carboys; ruptured tank; splashes from hose streams.	Use gas masks and boots; flush, absorb or neutralize, as conditions warrant. Flood or dilute large spills, and divert from incompatibles. (See **Acids** and **Alkalis** for recommended procedures.)*
2. Gas Poisoning	Fumes from nitric acid, or from acids and cyanides mixing (HCN); knocking cyanide "eggs" into water or acid solution; chlorinated hydrocarbons exposed to flames (phosgene).	Wear gas masks; beware of orange fumes; keep cyanide dry; beware of intermixed spills.
3. Skin Poisoning	Contact with solid cyanides; contact with cyanide solutions; contact with materials soaked in cyanide solutions.	Flood if large spill; stay out of solution; never put hand to mouth during overhaul work.
4. Electrical Shock	By 220 or 440 V. lines to building (bus bars carry only 6 to 12 volts, but as high as 3,000 amps, which makes a strong arc if "shorted").	Pull main switch.
5. Explosion	Ignition of buffing dust knocked off rafters, etc.	Use fog nozzles to minimize possibility of dislodging dust.
	Explosion of chromic anhydride if exposed to sudden elevated temperatures, or if mixed with alcohol, acetic acid, turpentine, acetone, etc.	Keep drums of chromic anhydride cool.
	Explosion of hydrogen from electrolyzed solution.	Ventilate evolved hydrogen.

*See first installment of "Fire Protection for Chemicals," published in the April, 1952 NFPA QUARTERLY.

Automatic Sprinkler Tables—1955 Edition

The National Fire Protection Association presents herewith a summary of the performance of automatic sprinklers at fires reported to the Department of Fire Record. Similar performance tables have been published periodically, the most recent appearing in the April 1950 *Quarterly*.

These tables show the reliability of automatic sprinklers as a primary means of fire control, and also point out those weaknesses in design or maintenance that can interfere with the effectiveness of sprinkler protection. The record of 96.2 per cent satisfactory performance (see Table 1) is a manifestation of the soundness of modern sprinkler standards and a tribute to the careful supervision by inspection departments, property owners, tenants and others responsible for the maintenance of sprinklers in operating condition at all times.

Since numerous fires, extinguished by one or two sprinklers, with a slight loss are not reported to NFPA, the record represents only a fraction of the total number of fires in sprinklered properties. If it were possible to include a complete record, the efficiency of sprinkler performance shown by these tables would even more nearly approach 100 per cent.

The NFPA Fire Record files, maintained since 1897, include reports of 110,129 fires in sprinklered buildings. Of these, there were 18,390, or 16.5 per cent, in which sprinklers were not a factor because the fires were extinguished by other means before automatic sprinklers had an opportunity to operate. Of the remaining 91,739 fires, 32,778 occurred prior to 1925, and 58,961 in 1925-1954, inclusive. The accompanying tables summarize in detail the sprinkler experience of this latter 30-year period.

Tables 2 and 3 show the number of sprinklers operating on fires during 1925-1954. In this 30-year period, operation of not more than two sprinklers was required to control 54.3 per cent of the fires. Six or less sprinklers controlled 76.6 per cent of the fires. Table 4 shows the 1950-1954 experience on the number of sprinklers operating. These Tables also give an indication of the comparative efficiency of wet and dry systems. In buildings where wet systems were installed 61.7 per cent of the fires were controlled by one or two sprinklers (see Table 2). The corresponding figure for dry systems was 34.4 per cent.

Effectiveness of sprinkler protection in 260 occupancies during the period 1925-1954 is given in Table 5. With the exception of metalworkers, the occupancies in the Table are about the same as those reported in 1950. The metalworking occupancies have been reclassified where practicable according to the specific metal and the process, for example, aluminum casting, steel forging. Table 6 summarizes sprinkler performance in nine broad occupancy groups.

Table 7 lists the reasons for unsatisfactory sprinkler performance by occupancy. As revealed in past analyses, closed sprinkler control valves continue to be the most frequent cause of unsatisfactory performance, being responsible for 36 per cent of all unsatisfactory performance reported. Table 8 gives the reasons for unsatisfactory performance in the broad occupancy groups.

A detailed analysis of unsatisfactory sprinkler performance is in Table 9.

Sprinkler performance by broad occupancy groups shows that mercantiles with 97.6 per cent efficiency have the best sprinkler performance record, whereas the storage occupancy record of 89.2 per cent was least satisfactory (Table 6).

In these tables the designation "Extinguished fire" generally indicates cases where the automatic sprinklers extinguished the fire unaided. "Held in check" indicates cases where the sprinklers did not extinguish the fire but kept it under control pending its extinguishment by other means. A typical example of "Held in check" is the case where a fire starts under a table where water from sprinklers cannot reach it, but the sprinklers prevent any spread of fire beyond the table until

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Table No. 1—Summary of Sprinkler Performance

	Fires from 1897-1924 Inc.		Fires from 1925-1954 Inc.	
	No.	Per Cent	No.	Per Cent
Practically or entirely extinguished	21843	66.7	35585	60.4
Held fire in check	9545	29.1	21121	35.8
Total Satisfactory	31388	95.8	56706	96.2
Unsatisfactory	1390	4.2	2255	3.8
Total	32778	100.0	58961	100.0

Table No. 2—Number of Sprinklers Operating—Cumulative 1925-1954

No. of Sprinklers Operating	Wet Systems Per Cent	Dry Systems Per Cent	Type of System Not Given Per Cent	Total No. of Fires	Total Fires Per Cent
1	43.2	21.0	28.1	22069	37.5
2 or less	61.7	34.4	42.3	32020	54.3
3 or less	70.7	43.5	50.8	37307	63.3
4 or less	76.6	50.5	56.8	40898	69.4
5 or less	80.5	55.2	60.5	43199	73.4
6 or less	83.4	59.4	64.3	45139	76.6
7 or less	85.5	62.8	66.5	46505	79.0
8 or less	87.3	65.6	69.0	47678	81.0
9 or less	88.6	68.1	70.5	48567	82.4
10 or less	89.5	70.0	71.7	49335	83.9
11 or less	90.5	71.6	72.9	49962	84.7
12 or less	91.3	73.6	74.2	50669	86.1
13 or less	92.0	74.9	75.1	51096	86.7
14 or less	92.7	76.2	76.2	51589	87.7
15 or less	93.2	77.4	77.0	51997	88.2
20 or less	95.1	81.4	79.7	53343	90.6
25 or less	96.3	84.4	81.2	54191	92.0
30 or less	96.8	86.5	82.4	54791	93.0
35 or less	97.3	88.0	83.3	55208	93.9
40 or less	97.6	89.2	84.1	55538	94.5
50 or less	98.2	90.8	85.3	55975	95.0
75 or less	98.7	92.9	86.5	56518	96.1
100 or less	98.9	93.9	87.0	56792	96.3
Over 100	99.5	97.1	89.0	57518	97.7
No data				1352	
Open head systems				91	
Total Fires				58961	

Table No. 3 — Number of Sprinklers Operating 1925-1954

No. of Sprinklers Operating	Per Cent of Fires		Per Cent	Totals	
	Wet-Pipe	Dry-Pipe	Type Not Given	No. Fires	Per Cent
1	43.4	21.0	28.1	22069	37.4
2	18.3	13.4	14.2	9951	16.9
3	9.1	9.1	8.6	5287	9.0
4	5.9	6.9	6.0	3591	6.1
5	3.8	4.7	3.6	2301	3.9
6	2.9	4.2	3.8	1940	3.3
7	2.0	3.4	2.3	1366	2.3
8	1.7	2.8	2.4	1173	2.0
9	1.3	2.5	1.5	889	1.5
10	1.1	1.9	1.4	769	1.3
11	1.0	1.6	1.0	627	1.1
12	0.9	2.1	1.4	707	1.2
13	0.6	1.2	0.9	427	0.7
14	0.6	1.5	1.0	493	0.8
15	0.6	1.0	0.8	408	0.7
16-20	1.8	4.0	2.6	1346	2.3
21-25	1.0	3.0	1.5	843	1.4
26-30	0.7	2.1	1.2	600	1.0
31-35	0.5	1.6	0.8	417	0.7
36-40	0.4	1.1	0.9	330	0.6
41-50	0.4	1.6	1.2	437	0.7
51-75	0.5	2.2	1.3	543	0.9
76-100	0.3	1.1	0.6	274	0.5
Over 100	0.6	3.0	1.9	726	1.2
No data	0.6	2.1	11.0	1352	2.3
Open head systems		0.9		91	0.2
Total	100.0	100.0	100.0	58961	100.0

Table No. 4 — Number of Sprinklers Operating 1950-1954

No. of Sprinklers Operating	Per Cent of Fires		Per Cent	Totals	
	Wet-Pipe	Dry-Pipe	Type Not Given	No. Fires	Per Cent
1	42.8	21.2	30.8	3227	37.3
2	16.9	10.4	15.6	1362	15.7
3	9.6	9.0	9.4	819	9.5
4	6.1	5.7	6.9	539	6.2
5	4.4	5.0	4.5	390	4.5
6	2.9	7.0	4.1	323	3.7
7	2.3	3.0	2.6	212	2.4
8	1.5	2.1	2.3	153	1.8
9	0.9	3.6	2.1	132	1.5
10	1.3	1.5	1.9	125	1.4
11	1.1	2.3	1.2	113	1.3
12	1.0	1.7	1.2	98	1.1
13	0.7	1.0	1.0	66	0.8
14	0.7	1.6	0.8	69	0.8
15	0.5	1.0	0.9	58	0.7
16-20	1.7	4.0	2.9	199	2.3
21-25	0.9	3.1	1.1	109	1.3
26-30	0.8	2.8	1.4	101	1.2
31-35	0.6	1.6	0.7	67	0.8
36-40	0.4	0.9	0.8	50	0.6
41-50	0.6	1.3	1.2	71	0.8
51-75	0.4	2.1	0.9	62	0.7
76-100	0.4	1.0	0.5	42	0.5
Over 100	0.6	0.9	1.2	66	0.8
No data	0.9	4.7	4.0	181	2.1
Open head systems	.....	1.5	.....	17	0.2
Total	100.0	100.0	100.0	8651	100.0

EFFECTIVENESS

Table No. 5 — ~~Effect~~ of Sprinklers by Class of Occupancy

	Extinguished Fire Per Cent	Held Fire in Check Per Cent	Total Satisfactory Per Cent	Unsatisfactory Per Cent	Total No. of Fires
Abrasive Works	60.4	31.3	91.7	8.3	48
Aircraft Assembling	22.2	77.8	100.0	0.0	36
Aircraft Hangars	62.5	37.5	100.0	0.0	16
Aluminum Casting	33.3	50.0	83.3	16.7	6
Aluminum Fabricating	47.0	41.2	88.2	11.8	17
Aluminum Milling	66.7	33.3	100.0	0.0	6
Aluminum Refining	50.0	50.0	100.0	0.0	2
Amusement Places	71.5	23.2	94.7	5.3	56
Apartments (No Mercantiles)	83.1	15.9	99.0	1.0	308
Apartments (With Mercantiles)	68.5	26.3	94.8	5.2	38
Artificial Flowers, etc., Mfg.	66.7	33.3	100.0	0.0	60
Artificial Leather Mfg.	57.6	39.4	97.0	3.0	99
Artificial Silk (See Rayon and Artificial Silk Mfg.)					
Asbestos Works	41.9	54.3	96.2	3.8	105
Asphalt Works	64.3	35.7	100.0	0.0	14
Automobile Factories (See Vehicle Assembling)					
Automobile Paint Shops	50.0	43.7	93.7	6.3	32
Auto Sales and Service	66.5	29.6	96.1	3.9	155
Bag Factories	59.1	34.6	93.7	6.3	110
Bakeries	62.5	34.9	97.7	2.6	421
Barns (See Stables and Barns)					
Battery Mfg.	55.7	39.0	94.7	5.3	95
Batting Mills (See Waste and Batting Mills)					
Bleaching (See Dyeing, Bleaching and Finishing)					
Bottle Caps and Seals Mfg.	55.3	44.7	100.0	0.0	67
Bottling Works	63.5	34.1	97.6	2.4	41
Bowling Alleys	73.9	16.6	90.5	9.5	42
Box Factories (Wood)	53.1	36.0	89.1	10.9	239
Braid Mills	77.8	22.2	100.0	0.0	90
Breweries	45.7	54.3	100.0	0.0	46
Brick and Tile Works	47.4	47.4	94.8	5.2	19
Broom Factories	81.9	13.6	95.5	4.5	44
Brush Factories	66.7	31.5	98.2	1.8	54
Builders' Supp. and Equip. Whses.	56.7	26.6	83.3	16.7	30
Buildings Under Construction	54.5	27.3	81.8	18.2	11
Button Factories	82.1	17.9	100.0	0.0	112
Candle Factories	66.7	33.3	100.0	0.0	12
Candy Factories	63.8	33.1	96.9	3.1	353
Canneries	59.1	34.1	93.2	6.8	44
Car Houses	45.8	48.5	94.3	5.7	35
Carbon Works	53.1	43.8	96.9	3.1	32
Carpet and Rug Mills	52.3	44.9	97.2	2.8	247
Casket Mfg.	56.3	37.0	93.3	6.7	119
Cement and Plaster Works	81.8	9.1	90.9	9.1	22
Cereal Mills	43.2	51.4	94.6	5.4	37
Chemical and Drug Warehouses	57.7	38.5	96.2	3.8	26
Chemical Works	48.0	47.5	95.5	4.5	737
Churches	84.6	15.4	100.0	0.0	13
Clothing Mfg.	80.0	18.8	98.8	1.2	2154
Clubs (City)	81.0	17.4	98.4	1.6	63
Clubs (Country)	70.3	25.7	96.0	4.0	101
Coal Sheds	31.2	50.0	81.2	18.8	16
Coffee and Spice Mills	61.9	36.8	98.7	1.3	155

	Extinguished Fire Per Cent	Held Fire in Check Per Cent	Total Satisfactory Per Cent	Unsatisfactory Per Cent	Total No. of Fires
Cold Storage Warehouses	75.0	17.5	92.5	7.5	40
Colleges (See Schools)					
Cooperage Plants	56.9	33.3	90.2	9.8	51
Copper, Tin, Zinc Casting	40.0	55.0	95.0	5.0	20
Copper, Tin, Zinc Fabricating	41.3	56.0	97.3	2.7	109
Copper, Tin, Zinc Milling	44.5	55.5	100.0	0.0	9
Copper, Tin, Zinc Refining	14.3	85.7	100.0	0.0	7
Cordage Works	60.5	34.9	94.9	5.1	157
Cork Plants	49.0	46.7	95.7	4.3	92
Cotton Gins	53.0	29.4	82.4	17.6	17
Cotton Mills	47.3	51.6	98.9	1.1	8464
Cotton Seed Oil Mills	28.6	30.6	59.2	40.8	49
Cotton Warehouses	40.5	45.9	86.4	13.6	445
Creameries (See Dairies and Creameries)					
Dairies and Creameries	55.5	41.7	97.2	2.8	36
Department Stores	79.4	17.8	97.2	2.8	965
Distilleries	42.6	46.8	89.4	10.6	47
Doll Factories	54.2	45.8	100.0	0.0	166
Door Manufacturing (See Sash, Door and Blind Factories)					
Drug Mfg.	74.4	23.1	97.5	2.5	273
Drug Warehouses (See Chemical and Drug Warehouses)					
Dry Cleaning Establishments	59.8	36.9	96.7	3.3	122
Dry Goods Stores	83.5	14.4	97.9	2.1	334
Dyeing, Bleaching and Finishing	54.5	42.4	96.9	3.1	513
Electrical Appliance Assembling	59.3	38.1	97.4	2.6	1211
Electrical Equipment Warehouses	60.7	32.1	92.8	7.2	28
Electric Power and Light Stations	66.7	22.2	88.9	11.1	18
Engine Fabricating	36.4	63.6	100.0	0.0	66
Engine Test Cells	0.0	83.3	83.3	16.7	6
Excelsior Factories	48.7	35.1	83.8	16.2	37
Feed Warehouses (See Grain Warehouses)					
Fertilizer Plants	46.7	40.0	86.7	13.3	15
Fibre Products Mfg.	39.1	53.6	92.7	7.3	138
Fibres Warehouses	30.4	43.5	73.9	26.1	23
Film Mfg. (See Photo, Camera and Film Mfg.)					
Fireworks Mfg.	28.6	42.8	71.4	28.6	7
Five Cent to $1.00 Stores	78.5	19.4	97.9	2.1	98
Flax and Linen Mills	64.3	33.3	97.6	2.4	42
Flour and Grist Mills	56.5	29.5	86.0	14.0	200
Food Products Mfg. (Misc.)	50.0	48.9	89.9	1.1	184
Food Products Warehouses	66.0	26.6	92.6	7.4	135
Forging (See Steel Forging)					
Foundries (See specific metal)					
Fur Works	78.3	18.5	96.8	3.2	308
Furniture Factories	61.8	30.7	92.5	7.5	1516
Furniture Stores	75.1	20.6	95.7	4.3	237
Furniture Warehouses	62.0	31.8	93.8	6.2	129
Garages	68.7	29.2	97.9	2.1	1097
Gas Works	50.0	37.5	87.5	12.5	8
Gasoline Filling Stations	83.4	16.6	100.0	0.0	6
General Storage Warehouses	64.7	28.6	93.3	6.7	119
Glass Factories	53.0	40.3	93.3	6.7	223
Glove Factories	65.6	34.4	100.0	0.0	29
Glucose (See Starch and Glucose)					
Glue Factories	26.3	63.2	89.5	10.5	19

	Extinguished Fire Per Cent	Held Fire in Check Per Cent	Total Satisfactory Per Cent	Unsatisfactory Per Cent	Total No. of Fires
Grain Elevators (Country)	56.7	33.3	90.0	10.0	30
Grain Elevators (Terminal)	56.5	20.5	77.0	23.0	39
Grain, Feed, Seed and Hay Whses.	40.5	43.3	83.8	16.2	37
Grist Mills (See Flour and Grist Mills)					
Grocery Stores	76.8	20.0	96.8	3.2	281
Grocery Wholesale Warehouses	46.1	38.4	84.5	15.5	13
Gum Mfg.	70.0	30.0	100.0	0.0	20
Hair Works	61.2	34.7	95.9	4.1	49
Hangars (See Aircraft Hangars)					
Hardware Stores	66.0	31.9	97.9	2.1	144
Hardware Warehouses	46.4	39.3	85.7	14.3	28
Hardwood Turning	53.0	36.5	89.5	10.5	257
Hat Factories	82.6	15.8	98.4	1.6	574
Hay Warehouses (See Grain Warehouses)					
Hospitals	76.1	20.5	96.6	3.4	117
Hotels (Seasonal)	75.9	18.1	94.0	6.0	83
Hotels (Year Round)	79.2	17.9	97.2	2.8	318
Ice Mfg.	50.0	37.5	87.5	12.5	8
Ice Cream Mfg.	60.0	40.0	100.0	0.0	15
Idle and Vacant Property	50.0	25.8	75.8	24.2	128
Incandescent Lamp Works	80.0	20.0	100.0	0.0	15
Institutions	82.5	15.0	97.5	2.5	40
Interior Woodwork Mfg.	54.3	33.6	87.9	12.1	304
Iron Casting	34.6	61.9	96.5	3.5	309
Iron Conversion	68.7	31.3	100.0	0.0	16
Iron Fabricating	37.7	60.0	97.7	2.3	220
Iron Smelting and Refining	50.0	50.0	100.0	0.0	8
Jewelry Fabricating	56.7	41.2	97.9	2.1	238
Junk Shops	61.4	29.8	91.2	8.8	57
Knitting Mills (Cop Yarn)	68.0	29.2	97.2	2.8	72
Knitting Mills (Full Process)	76.1	21.2	97.3	2.7	406
Lampshade Factories	82.1	14.3	96.4	3.6	84
Laundries	63.6	33.4	97.0	3.0	503
Leather, Leather Products, Whses.	80.0	20.0	100.0	0.0	20
Leather Tanneries (Misc.)	44.7	38.3	83.0	17.0	47
Leather Tanneries (Sole, Belting)	50.7	38.8	89.5	10.5	67
Leather Tanneries (Upper)	63.0	31.6	94.6	5.4	205
Leather Working	73.0	25.3	98.3	1.7	470
Linen Mills (See Flax and Linen Mills)					
Linoleum Works	37.5	55.0	92.5	7.5	120
Linseed Oil Works	47.1	29.4	76.5	23.5	34
Liquor Warehouses	37.5	37.5	75.0	25.0	16
Lithographing (See Printing and Lithographing)					
Lumber Sheds	38.8	50.5	89.3	10.7	103
Macaroni Factories	46.2	50.0	96.2	3.8	26
Machine Shops (See Metal Machining)					
Magnesium Casting	42.9	42.9	85.8	14.2	7
Magnesium Fabricating	28.6	71.4	100.0	0.0	7
Magnesium Refining	0.0	0.0	0.0	100.0	1
Mail Order Houses	82.3	17.7	100.0	0.0	51
Manufacturing, Misc.	33.3	33.3	66.7	3.3	6
Match Factories	75.3	20.8	96.1	3.9	77
Mattress Factories	68.1	29.2	97.3	2.7	838
Mercantiles (Misc.)	79.7	17.9	97.6	2.4	1202

	Extinguished Fire Per Cent	Held Fire in Check Per Cent	Total Satisfactory Per Cent	Unsatisfactory Per Cent	Total No. of Fires
Mercantile Stock Warehouses	55.4	40.4	95.8	4.2	47
Metal Machining	65.5	32.5	98.0	2.0	594
Metal Plating	32.4	64.8	97.2	2.8	71
Metals, Misc., Casting	25.0	75.0	100.0	0.0	8
Metals, Misc., Fabricating	38.4	60.1	98.5	1.5	138
Metals, Misc., Milling	100.0	0.0	100.0	0.0	1
Metals, Misc., Refining	28.6	57.1	85.7	14.3	7
Metals Warehouses	42.5	50.0	92.5	7.5	40
Mining Property	67.5	22.5	90.0	10.0	40
Mirror Mfg.	82.7	13.8	96.5	3.5	29
Miscellaneous	66.4	20.7	87.1	12.9	116
Motion Picture Exchanges	66.2	28.8	95.0	5.0	80
Motion Picture Studios	70.7	26.0	96.7	3.3	123
Motion Picture Theatres	72.6	21.1	93.7	6.3	128
Multiple Occupancies (See also Tenant Mfg.; Apartments with Mercantiles)	72.8	23.7	96.5	3.5	1265
Multiple Occupancy Warehouses	60.0	18.3	78.3	21.7	60
Munitions	50.0	42.1	92.1	7.9	38
Office Buildings	79.5	18.8	98.3	1.7	244
Oil Cloth Mfg.	55.3	44.7	100.0	0.0	38
Oil Clothing Mfg.	52.7	36.8	89.5	10.5	19
Oil Refineries (Animal)	60.0	26.7	86.7	13.3	15
Oil Refineries (Mineral)	58.0	36.8	94.8	5.2	19
Oil Refineries (Vegetable)	46.5	42.9	89.4	10.6	56
Optical Works	61.3	38.7	98.9	0.0	93
Packing Plants (Fruit and Veg.)	68.2	31.8	100.0	0.0	22
Packing Houses (Meat)	52.6	41.5	94.2	5.9	272
Pails and Woodenware Mfg.	50.0	42.0	92.0	8.0	50
Paint Shops	59.3	33.3	92.6	7.4	27
Paint and Varnish Works	55.2	40.3	95.5	4.5	532
Paper Coating Mills	58.6	35.6	94.2	5.8	87
Paper Mills	44.4	50.0	94.4	5.6	1444
Paper Warehouses	63.7	26.4	90.1	9.9	91
Paper Working	56.2	40.7	96.9	3.1	1032
Patent Leather Mfg.	54.2	37.5	91.7	8.3	24
Peanut Plants	35.0	35.0	70.0	30.0	20
Phonograph Works	58.4	38.8	97.2	2.8	36
Photo Camera and Film Mfg.	62.4	37.6	100.0	0.0	77
Photo Engraving and Studios	87.9	12.1	100.0	0.0	91
Picture Frame Mfg.	68.9	31.1	100.0	0.0	45
Piers and Wharves	56.0	36.0	92.0	8.0	75
Planing Mills (See Saw and Planing Mills)					
Plaster Works (See Cement and Plaster Works)					
Plastics Fabricating	44.0	52.0	96.0	4.0	25
Plastics Mfg.	40.3	50.7	91.0	9.0	67
Plumbers Supplies Mfg.	66.7	25.6	92.3	7.7	39
Potteries	44.7	44.7	89.4	10.6	47
Printing and Lithographing	77.7	21.1	98.8	1.2	1388
Prisons	56.5	34.8	91.3	8.7	23
Public Buildings	78.9	12.1	91.0	9.0	33
Public Household Furniture Whses.	66.7	29.1	95.8	4.2	24
Pulp Mills	42.9	42.9	85.8	14.2	56
Pyroxylin Mfg.	67.6	23.6	91.2	8.8	68
Pyroxylin Novelties Mfg.	74.4	22.4	96.8	3.2	183
Pyroxylin Scrap Reclaiming, Stge.	54.7	33.7	88.4	11.6	86

	Extinguished Fire Per Cent	Held Fire in Check Per Cent	Total Satisfactory Per Cent	Unsatisfactory Per Cent	Total No. of Fires
Radio Mfg. (See Electrical Appliance Assembling)					
Radio, TV Studios	50.0	50.0	100.0	0.0	4
Railroad Misc. Property	69.4	27.8	97.2	2.8	36
Railroad Repair Shops	28.6	71.4	100.0	0.0	14
Rayon and Artificial Silk Mfg.	44.7	48.5	93.2	6.8	132
Research Laboratories (See Scientific and Research Laboratories)					
Restaurants	72.0	27.2	99.2	0.8	464
Rice Mills	33.3	33.3	66.7	33.3	15
Rolling and Plate Mills (See Steel Rolling and Stripping)					
Roofing Mfg.	27.9	66.1	94.0	6.0	233
Rooming Houses	77.8	16.7	94.5	5.5	18
Rubber Cloth Factories	64.9	32.4	97.3	2.7	182
Rubber Mills	49.5	46.0	95.5	4.5	774
Rubber Reclaiming	50.0	34.4	84.4	15.6	64
Rubber Warehouses	66.7	22.2	88.9	11.1	18
Rug Mills (See Carpet and Rug Mills)					
Sash, Door and Blind Factories	52.0	40.1	92.1	7.9	177
Saw and Planing Mills	35.6	33.6	69.2	30.8	205
Schools (Colleges and Universities)	74.5	20.0	94.5	5.5	55
Schools (Private)	76.8	23.2	100.0	0.0	43
Schools (Public)	59.4	25.0	84.4	15.6	32
Schools (Trade)	71.5	19.0	90.5	9.5	21
Scientific and Research Laboratories	59.1	40.9	100.0	0.0	44
Seed Warehouses (See Grain Warehouses)					
Shipyards	52.5	37.3	89.8	10.2	59
Shoddy Mills	55.3	39.4	94.7	5.3	226
Shoe Accessories Mfg.	67.9	24.3	92.2	7.8	115
Shoe Factories	74.5	22.5	97.0	3.0	1181
Shoe Last Mfg. (See Wooden Heel and Shoe Last Factories)					
Shoe Stores	84.9	15.1	100.0	0.0	99
Silk Mills	80.8	16.5	97.3	2.7	182
Skin Mills	57.7	32.7	90.4	9.6	52
Soap Mfg.	55.2	40.3	95.5	4.5	87
Soybean Milling and Refining	26.6	40.0	66.7	33.3	15
Spice Mills (See Coffee and Spice Mills)					
Stables and Barns	66.7	27.8	94.5	5.5	18
Starch and Glucose Mfg.	58.9	35.2	94.1	5.9	17
Steel Casting	33.3	61.8	95.1	4.9	162
Steel Fabricating	38.3	58.1	96.4	3.6	2949
Steel Forging	49.3	44.9	94.2	5.8	69
Steel Rolling and Stripping	56.0	41.2	97.2	2.8	216
Stone Working	60.0	35.0	95.0	5.0	20
Studios (See Photo Engraving and Studios)					
Sugar Refineries	42.5	53.4	95.9	4.1	73
Telephone Exchanges	85.7	14.3	100.0	0.0	7
Tenant Mfg.	73.4	23.5	96.9	3.1	4389
Terminal Warehouses	48.7	43.6	92.3	7.7	78
Textile Warehouses	50.0	39.3	89.3	10.7	28
Theatres	78.6	16.3	94.9	5.1	98
Tile Works (See Brick and Tile Works)					
Tin (See Copper)					
Tobacco Factories	58.8	37.7	96.5	3.5	114
Tobacco Warehouses	68.6	22.8	91.4	8.6	35
Toy Mfg. (Wood and Metal)	48.2	48.2	96.3	3.7	54
Trunk Factories	78.0	7.3	85.3	14.7	41
TV Studios (See Radio, TV Studios)					

	Extinguished Fire Per Cent	Held Fire in Check Per Cent	Total Satisfactory Per Cent	Unsatisfactory Per Cent	Total No. of Fires
Umbrella Mfg.	74.2	22.6	96.8	3.2	31
Universities (See Schools)					
Upholstering	57.7	42.3	100.0	0.0	59
Vacant Property (See Idle and Vacant Property)					
Varnish Works (See Paint and Varnish Works)					
Vechicle Assembling	35.9	59.6	95.5	4.5	334
Wall Paper Factories	71.5	28.5	100.0	0.0	21
Warehouses (Miscellaneous)	60.9	31.4	92.3	7.7	194
Waste and Batting Mills	58.0	35.6	93.6	5.4	467
Waste Paper and Rag Shops	60.1	35.0	95.1	4.9	708
Waste Warehouses	41.7	47.3	89.0	11.0	36
Water Works	50.0	50.0	100.0	0.0	2
Weaving Mills	72.6	22.3	99.1	0.9	559
Wharves (See Piers and Wharves)					
Wholesale Mercantiles	89.5	10.5	100.0	0.0	19
Window Shade Mfg.	69.5	26.1	95.6	4.4	23
Wire Fabricating	34.6	61.2	95.8	4.2	260
Wooden Heel and Shoe Last Mfg.	75.6	21.1	96.7	3.3	123
Wood Flour Mills	27.6	55.2	82.8	17.2	29
Wood and Wood Products Whses.	44.5	44.5	89.0	11.0	18
Woodworkers (Misc.)	54.5	40.8	95.3	4.7	571
Wool Scouring Plants	63.4	28.3	91.7	8.3	60
Woolen Mills	61.5	34.2	95.7	4.3	1078
Wool Warehouses	50.0	35.0	85.0	15.0	20
Worsted Mills	74.7	23.1	97.8	2.2	91
Zinc (See Copper)					
Total					58961

Table No. 6 — Sprinkler Performance by Occupancy Groups

Occupancy Group	Extinguished Fire Per Cent	Held Fire in Check Per Cent	Total Satisfactory Per Cent	Unsatisfactory Per Cent	Total No. of Fires
Residential	79.9	17.5	97.4	2.6	765
Assembly	73.8	20.7	94.5	5.5	652
Institutional	75.0	21.1	96.1	3.9	180
Offices	79.5	18.0	97.5	2.5	277
Mercantile	77.7	19.9	97.6	2.4	4022
Manufacturing					
Chemicals and Chemical Products	52.9	40.9	93.8	6.2	2967
Fibre Products	56.3	38.4	94.7	5.3	393
Food Products	57.2	38.1	95.3	4.7	2005
Glass Products	58.7	36.9	95.6	4.4	360
Leather Working	70.2	25.7	95.9	4.1	2301
Metal and Metal Products	45.3	51.4	96.7	3.3	7266
Mineral Products	51.0	42.5	93.5	6.5	261
Paper and Paper Products	52.8	42.7	95.5	4.5	3443
Printing and Engraving	78.4	20.4	98.8	1.2	1479
Rubber and Rubber Products	52.3	42.8	95.1	4.9	1020
Tenant Mfg.	73.4	23.5	96.9	3.1	4389
Textiles and Textile Products	58.6	39.5	98.1	1.9	16926
Woodworking	56.2	34.8	91.0	9.0	3925
Miscellaneous Manufacturing	61.3	34.9	96.2	3.8	603
Total Manufacturing	(58.0)	(38.4)	(96.4)	(3.6)	(47338)
Storage	53.0	36.2	89.2	10.8	1966
Miscellaneous Occupancies	65.1	30.4	95.5	4.5	2496
Multiple Occupancies	72.8	23.7	96.5	3.5	1265
Total					58961

Table No. 7 — Classification of Unsatisfactory Sprinkler Fires by Occupancy

	Water Shut Off	Partial Protection	Inadequate Water Supplies	System Frozen	Slow Operation	Defective Dry Pipe Valve	Faulty Building Construction	Obstruction to Distribution	Hazard of Occupancy	Exposure Fire	Inadequate Maintenance	Antiquated System	Miscellaneous and Unknown	Total
Abrasive Works	1	1					1				1			4
Aluminum Casting	1													1
Aluminum Fabricating								1	1					2
Amusement Places	2										1			3
Apartments (No Mercantiles)		2						1						3
Apartments (With Merc.)	1								1					2
Artificial Leather Mfg.							1		2					3
Asbestos Works	3	1												4
Automobile Paint Shops	2													2
Auto Sales and Service	4		1						1					6
Bag Factories	4							1			2			7
Bakeries	4						1	4	1		1			11
Battery Mfg.	2		2								1			5
Bottling Works	1													1
Bowling Alleys	2	1					1							4
Box Factories (Wood)	7	2	6	1	1	1	1		4	1	1	1		26
Brick and Tile Works												1		1
Broom Factories	1		1											2
Brush Factories	1													1
Builders' Supplies, Eq. Whse.	4		1											5
Buildings Under Construction	2													2
Candy Factories	4	2					1		1	1	2			11
Canneries	1		1				1							3
Car Houses		1									1			2
Carbon Works								1						1
Carpet and Rug Mills	1				2			2	1				1	7
Casket Mfg.	2		2			1	1				1		1	8
Cement and Plaster Works	1	1												2
Cereal Mills	1								1					2
Chemical and Drug Whse.									1					1
Chemical Works	2	2	4		1			2	19		3			33
Clothing Mfg.	10	3	4				3	2		1	2		1	26
Clubs (City)	1													1
Clubs (Country)	1	2	1											4
Coal Sheds	3													3
Coffee and Spice Mills		2												2
Cold Storage Warehouses	1			1					1					3
Cooperage Plants		2					1	1		1				5
Copper, Tin, Zinc Casting	1													1
Copper, Tin, Zinc Fabricating	1	1	1											3
Cordage Works	2		1			1		1	1		1	1		8
Cork Plants			1				1		2					4
Cotton Gins	2	1												3
Cotton Mills	31	2	6		2	1	1	8	8		22	2	5	88
Cotton Seed Oil Mills	5		7						2	1	1	3	1	20
Cotton Warehouses	15	2	11	1	3	2	1	12	2		11	1		61
Dairies and Creameries	1													1
Department Stores	14	2	1			1	4	3			1	1		27
Distilleries									4			1		5

	Water Shut Off	Partial Protection	Inadequate Water Supplies	System Frozen	Slow Operation	Defective Dry Pipe Valve	Faulty Building Construction	Obstruction to Distribution	Hazard of Occupancy	Exposure Fire	Inadequate Maintenance	Antiquated System	Miscellaneous and Unknown	Total
Drug Mfg.	4	1	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	7
Dry Cleaning Establishments	1	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....	.....	4
Dry Goods Stores	6	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	7
Dyeing, Bleaching, Finishing	9	.....	.....	.....	1	.....	1	3	.....	.....	2	.....	.....	16
Electrical Appliance Assemb'g	9	3	2	.....	3	1	2	6	3	.....	2	1	.....	32
Electrical Equipment Whses.	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	2
Electric Power and Light Sta.	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Engine Test Cells	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1
Excelsior Factories	.....	.....	3	.....	1	1	.....	.....	1	.....	.....	.....	.....	6
Fertilizer Plants	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	2
Fibre Products	2	.....	1	.....	.....	1	.....	4	1	.....	1	.....	.....	10
Fibres Warehouses	1	.....	.....	.....	.....	.....	.....	4	1	.....	.....	.....	.....	6
Fireworks Mfg.	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	2
Five Cent to $1.00 Stores	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	2
Flax and Linen Mills	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
Flour and Grist Mills	6	3	1	.....	1	.....	1	.....	10	1	1	.....	4	28
Food Products Mfg. (Misc.)	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	2
Food Products Warehouses	5	1	1	.....	.....	1	.....	.....	1	.....	.....	.....	1	10
Fur Works	3	.....	1	.....	2	.....	.....	2	.....	.....	.....	1	1	10
Furniture Factories	40	10	18	1	3	5	8	2	19	1	3	2	2	114
Furniture Stores	7	.....	.....	.....	.....	.....	2	.....	.....	.....	1	.....	.....	10
Furniture Warehouses	4	.....	.....	.....	.....	1	.....	1	1	.....	1	.....	.....	8
Garages	13	1	1	2	.....	1	1	1	2	.....	1	.....	.....	23
Gas Works	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1
General Storage Warehouses	1	.....	2	.....	.....	1	1	.....	1	1	.....	1	.....	8
Glass Factories	6	.....	1	1	.....	.....	2	1	3	.....	1	.....	.....	15
Glue Factories	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2
Grain Elevators (Country)	1	.....	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	3
Grain Elevators (Terminal)	2	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	2	.....	9
Grain, Feed, Seed, Hay Whs.	2	2	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
Grocery Stores	4	1	.....	.....	1	.....	2	.....	1	.....	.....	.....	.....	9
Grocery Wholesale Whse.	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	2
Hair Works	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2
Hardware Stores	2	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	3
Hardware Warehouses	2	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	4
Hardwood Turning	9	1	2	.....	.....	.....	5	1	3	1	3	1	1	27
Hat Factories	5	.....	.....	.....	.....	.....	1	1	1	.....	1	.....	.....	9
Hospitals	2	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....	4
Hotels (Seasonal)	.....	.....	.....	1	.....	.....	2	.....	.....	.....	1	1	.....	5
Hotels (Year Round)	4	1	.....	.....	.....	.....	3	.....	.....	.....	.....	1	.....	9
Ice Mfg.	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
Idle and Vacant Property	26	.....	.....	.....	.....	.....	.....	1	1	1	1	.....	1	31
Iron Casting	6	.....	.....	1	.....	.....	1	1	2	.....	.....	.....	.....	11
Iron Fabricating	1	.....	.....	.....	.....	1	1	.....	1	.....	1	.....	.....	5
Institutions	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Interior Woodwork Mfg.	10	4	8	1	3	1	2	3	3	.....	2	.....	.....	37
Jewelry Factories	3	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	5
Junk Shops	3	.....	.....	.....	1	.....	.....	.....	.....	1	.....	.....	.....	5
Knitting Mills (Cop Yarn)	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2
Knitting Mills (Full Process)	7	.....	.....	.....	.....	1	.....	1	.....	.....	2	.....	.....	11

	Water Shut off	Partial Protection	Inadequate Water Supplies	System Frozen	Slow Operation	Defective Dry Pipe Valve	Faulty Building Construction	Obstruction to Distribution	Hazard of Occupancy	Exposure Fire	Inadequate Maintenance	Antiquated System	Miscellaneous and Unknown	Total
Lampshade Factories	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	3
Laundries	8	2	1	.....	.....	.....	2	.....	1	.....	.....	1	.....	15
Leather Tanneries (Misc.)	5	.....	1	.....	.....	.....	.....	.....	.....	.....	1	.....	1	8
Leather Tan. (Sole, Belting)	2	.....	1	.....	.....	.....	1	.....	1	1	.....	1	.....	7
Leather Tanneries (Upper)	7	1	.....	.....	.....	2	1	.....	.....	.....	.....	.....	.....	11
Leather Working	3	.....	1	.....	.....	.....	.....	1	2	.....	1	.....	.....	8
Linoleum Works	.....	1	1	.....	1	.....	2	1	2	.....	.....	.....	1	9
Linseed Oil Works	1	.....	.....	.....	.....	.....	1	1	3	.....	1	1	.....	8
Liquor Warehouses	2	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	4
Lumber Sheds	.....	4	1	.....	1	.....	1	.....	1	2	.....	.....	1	11
Macaroni Factories	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Magnesium Casting	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
Magnesium Refining	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Manufacturing, Misc.	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2
Match Factories	1	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	3
Mattress Factories	16	1	1	.....	.....	.....	.....	3	.....	.....	.....	.....	2	23
Mercantile (Misc.)	14	2	.....	.....	1	.....	6	2	1	1	2	.....	.....	29
Mercantile Stock Warehouses	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Metal Machining	6	.....	1	.....	.....	.....	.....	.....	2	.....	3	.....	.....	12
Metal Plating	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2
Metals, Misc. Fabricating	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2
Metals, Misc. Refining	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1
Metal Warehouses	1	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
Mining Property	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
Mirror Mfg.	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Miscellaneous	7	.....	.....	.....	.....	.....	1	.....	3	.....	2	1	1	15
Motion Picture Exchanges	.....	.....	.....	.....	.....	1	.....	.....	3	.....	.....	.....	.....	4
Motion Picture Studios	1	1	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	4
Motion Picture Theatres	2	3	.....	.....	.....	.....	1	.....	.....	1	1	.....	.....	8
Multiple Occupancies	15	2	2	4	1	2	11	3	4	.....	.....	.....	.....	44
Multiple Occupancy Whses.	6	2	1	.....	.....	.....	1	1	1	.....	1	.....	.....	13
Munitions	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	3
Office Buildings	2	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	4
Oil Clothing Mfg.	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2
Oil Refineries (Animal)	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2
Oil Refineries (Mineral)	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1
Oil Refineries (Vegetable)	2	.....	.....	.....	.....	.....	.....	.....	2	1	1	.....	.....	6
Packing Houses	10	.....	1	.....	.....	.....	2	.....	1	.....	2	.....	.....	16
Pails and Woodenware Mfg.	.....	2	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	4
Paint Shops	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Paint and Varnish Works	5	1	4	.....	1	1	.....	.....	10	.....	1	.....	1	24
Paper Coating Mills	1	.....	.....	.....	.....	.....	.....	2	1	.....	.....	1	.....	5
Paper Mills	28	2	17	.....	1	.....	3	12	5	1	9	2	1	81
Paper Warehouses	3	.....	.....	.....	.....	1	.....	2	.....	.....	3	.....	.....	9
Paper Working	6	3	3	.....	.....	.....	4	8	2	.....	5	1	.....	32
Patent Leather Mfg.	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	2
Peanut Plants	3	.....	.....	.....	1	.....	.....	.....	.....	2	.....	.....	.....	6
Phonograph Works	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Piers and Wharves	1	3	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	6
Plastic Fabricating	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Plastics Mfg.	2	.....	.....	.....	.....	.....	1	1	2	.....	.....	.....	.....	6
Plumbers Supplies Mfg.	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3

	Water Shut off	Partial Protection	Inadequate Water Supplies	System Frozen	Slow Operation	Defective Dry Pipe Valve	Faulty Building Construction	Obstruction to Distribution	Hazard of Occupancy	Exposure Fire	Inadequate Maintenance	Antiquated System	Miscellaneous and Unknown	Total
Potteries	2	1	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
Printing and Lithographing	8	2	.....	.....	.....	1	3	1	.....	.....	1	.....	1	17
Prisons	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2
Public Buildings	.....	.....	1	.....	.....	1	.....	.....	.....	.....	1	.....	.....	3
Public Hhld. Furn. Whses	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
Pulp Mills	5	2	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	8
Pyroxylin Mfg.	.....	.....	.....	.....	.....	.....	.....	.....	6	.....	.....	.....	.....	6
Pyroxylin Novelties Mfg.	4	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	6
Pyroxylin Scrap Recl., Stge	.....	.....	.....	.....	.....	.....	.....	.....	9	1	.....	.....	.....	10
Railroad Misc. Property	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
Rayon and Artificial Silk Mfg.	3	.....	1	.....	.....	.....	.....	2	1	.....	1	.....	1	9
Restaurants	1	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	4
Rice Mills	1	.....	1	.....	.....	.....	.....	1	.....	.....	.....	1	1	5
Roofing Mfg.	1	1	2	.....	.....	.....	.....	4	2	.....	2	.....	2	14
Rooming Houses	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Rubber Cloth Factories	3	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	5
Rubber Mills	10	3	2	.....	.....	1	.....	6	10	.....	3	.....	.....	35
Rubber Reclaiming	3	1	1	.....	.....	.....	.....	2	2	1	.....	.....	.....	10
Rubber Warehouse	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	2
Sash, Door and Blind Factories	4	2	.....	.....	.....	2	1	1	1	.....	1	2	.....	14
Saw and Planing Mills	15	11	11	2	4	.....	1	4	10	2	1	2	.....	63
Schools (Colleges and Univ.)	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	3
Schools (Public)	1	2	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	5
Schools (Trade)	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Shipyards	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
Shoddy Mills	1	.....	2	1	.....	1	1	2	1	.....	1	2	.....	12
Shoe Accessories Mfg.	4	1	.....	1	.....	.....	.....	.....	1	.....	.....	2	.....	9
Shoe Factories	9	2	.....	1	1	1	3	5	3	1	5	3	1	35
Silk Mills	3	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	.....	5
Skin Mills	.....	1	.....	1	1	1	1	.....	.....	.....	.....	.....	.....	5
Soap Mfg.	3	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	4
Soy Bean Milling and Refining	2	1	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
Stables and Barns	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Starch and Glucose	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
Steel Casting	5	.....	.....	.....	.....	1	.....	1	.....	.....	.....	1	.....	8
Steel Fabricating	21	17	8	.....	3	.....	5	17	14	4	8	5	5	107
Steel Forging	.....	.....	1	.....	.....	.....	.....	.....	1	.....	2	.....	.....	4
Steel Rolling and Stripping	1	.....	.....	.....	.....	1	.....	1	1	1	1	.....	.....	6
Stone Working	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Sugar Refineries	1	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	3
Tenant Mfg.	75	7	4	3	1	.....	7	6	8	3	15	5	1	135
Terminal Warehouses	3	.....	.....	.....	.....	.....	.....	1	1	1	.....	.....	.....	6
Textile Warehouses	1	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	3
Theatres	4	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	5
Tobacco Factories	1	.....	1	.....	.....	.....	1	.....	.....	.....	1	.....	.....	4
Tobacco Warehouses	.....	.....	1	.....	.....	.....	1	.....	.....	1	.....	.....	.....	3
Toy Mfg. (Wood and Metal)	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Trunk Factories	3	.....	1	.....	.....	.....	1	.....	.....	1	.....	.....	.....	6
Umbrella Mfg.	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
Vehicle Assembling	3	3	1	.....	.....	.....	.....	3	3	.....	2	.....	.....	15

	Water Shut off	Partial Protection	Inadequate Water Supplies	System Frozen	Slow Operation	Defective Dry Pipe Valve	Faulty Building Construction	Obstruction to Distribution	Hazard of Occupancy	Exposure Fire	Inadequate Maintenance	Antiquated System	Miscellaneous and Unknown	Total
Warehouses (Miscellaneous)	6	1	2	.....	.....	.....	1	3	.....	1	1	.....	.....	15
Waste and Batting Mills	15	2	3	.....	1	.....	1	2	1	.....	4	.....	1	30
Waste Paper and Rag Shops	12	.....	2	2	1	.....	1	7	5	1	3	.....	1	35
Waste Warehouses	2	.....	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	4
Weaving Mills	.....	.....	1	.....	.....	.....	.....	3	.....	.....	1	.....	.....	5
Window Shade Mfg.	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
Wire Fabricating	3	4	.....	.....	.....	.....	.....	1	1	.....	2	.....	.....	11
Wooden Heel and Last Mfg.	2	.....	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	4
Wood Flour Mills	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	.....	.....	5
Wood and Wood Prod. Whse.	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	2
Woodworkers (Misc.)	9	1	5	.....	1	.....	1	2	4	1	1	2	.....	27
Wool Scouring Plants	1	.....	1	.....	.....	.....	1	1	.....	.....	.....	1	.....	5
Woolen Mills	17	2	7	.....	1	.....	1	5	3	.....	7	3	.....	46
Wool Warehouses	2	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	3
Worsted Mills	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2
Total	808	167	205	26	48	42	139	201	288	43	184	62	42	2255

Table No. 8 — Unsatisfactory Sprinkler Performance by Occupancy Groups

	Water Shut off	Partial Protection	Inadequate Water Supplies	System Frozen	Slow Operation	Defective Dry Pipe Valve	Faulty Building Construction	Obstruction to Distribution	Hazard of Occupancy	Exposure Fire	Inadequate Maintenance	Antiquated System	Miscellaneous and Unknown	Total
Residential	6	3	.....	1	.....	.....	5	1	1	.....	1	2	.....	20
Assembly	15	9	2	.....	.....	.....	5	.....	.....	1	2	1	.....	35
Institutional	2	1	1	.....	.....	.....	1	.....	1	.....	.....	1	.....	7
Offices	2	.....	1	.....	.....	1	.....	.....	1	.....	1	1	.....	7
Mercantile	49	5	1	.....	2	1	21	5	4	1	5	1	.....	95
Manufacturing														
Chemicals, Chemical Products	38	8	22	.....	3	2	2	12	73	4	11	5	5	185
Fibre Products	6	.....	3	.....	.....	2	.....	5	2	.....	2	1	.....	21
Food Products	34	7	4	.....	2	.....	7	7	16	6	5	1	5	94
Glass Products	7	.....	1	1	.....	.....	2	1	3	.....	1	.....	.....	16
Leather Working	34	5	4	3	2	4	8	6	9	4	7	6	2	94
Metal and Metal Products	68	32	13	1	6	5	9	32	32	4	24	7	5	238
Mineral Products	8	4	2	.....	.....	.....	1	.....	.....	.....	1	1	.....	17
Paper and Paper Products	47	6	23	2	2	.....	8	29	13	2	17	4	3	156
Printing and Engraving	8	2	.....	.....	.....	1	3	1	.....	.....	1	.....	1	17
Rubber and Rubber Products	16	4	3	.....	.....	1	.....	9	12	1	4	.....	.....	50
Tenant Mfg.	75	7	4	3	1	.....	7	6	8	3	15	5	1	135
Textiles and Textile Products	127	14	27	1	10	3	13	37	22	1	47	9	12	323
Woodworking	103	37	59	5	13	11	23	15	52	7	15	10	4	354
Miscellaneous Manufacturing	12	.....	5	.....	1	.....	1	.....	.....	1	2	1	.....	23
Total Manufacturing	**583**	**126**	**170**	**16**	**40**	**29**	**84**	**160**	**242**	**33**	**152**	**50**	**38**	**1723**
Storage	71	13	25	3	5	7	8	30	20	6	18	4	2	212
Miscellaneous Occupancies	65	8	3	2	.....	2	4	2	15	2	5	2	2	112
Multiple Occupancies	15	2	2	4	1	2	11	3	4	.....	.....	.....	.....	44
Total	808	167	205	26	48	42	139	201	288	43	184	62	42	2255

Table No. 9 — Detailed Analysis of Unsatisfactory Sprinkler Performance

	Residential	Assembly	Institutional	Offices	Mercantile	Manufacturing	Storage	Miscellaneous Occupancies	Multiple Occupancies	Total
Water to Sprinklers shut off										
Valve defective or leaky	....	....	....	....	....	2	....	....	....	2
Unsupervised valve closed for undetermined reason	....	6	1	....	6	137	23	11	5	189
Premature shut off	....	2	....	....	7	148	12	4	3	176
Alterations or repairs to system	1	3	....	1	10	126	15	14	1	171
To prevent freezing	1	1	1	1	18	97	11	25	5	160
Cold weather valve closed out of season	....	1	....	....	2	20	2	1	....	26
To abet arson	1	1	....	....	4	23	5	6	1	41
Fear of water damage	....	....	....	....	....	16	1	....	....	17
Miscellaneous other reasons	3	1	....	....	2	14	2	4	....	26
Partial protection										
Originated in unsprinklered area	3	9	1	....	5	126	13	8	2	167
Inadequate water supply										
Insufficient water or low water pressure from public supply	....	1	....	....	1	87	12	2	1	104
Insufficient water or low water pressure from private supply	....	....	1	....	....	13	2	....	....	16
Insufficient water for both sprinklers and hose streams	....	1	....	1	....	29	6	1	....	38
Gravity tank empty	....	....	....	....	....	19	3	....	....	22
Pump failure or pump not started	....	....	....	....	....	10	....	....	....	10
Mains broken	....	....	....	....	....	6	1	....	1	8
Miscellaneous reasons	....	....	....	....	....	6	1	....	....	7
System frozen										
Pipes or valves frozen	1	....	....	....	....	16	3	2	4	26
Slow operation										
Excessive heads on dry pipe valve	....	....	....	....	....	19	....	....	....	19
High temperature sprinklers	....	....	....	....	....	7	....	....	....	7
Failure of quick opening device	....	....	....	....	....	2	....	....	....	2
Heat actuating devices inadequate or inoperative	....	....	....	....	....	3	....	....	....	3
Miscellaneous reasons	....	....	....	....	2	9	5	....	1	17
Defective dry pipe valve										
Defective or improperly adjusted dry pipe valve	....	....	....	1	1	29	7	2	2	42
Faulty building construction										
Concealed horizontal or vertical spaces lacking protection	5	5	1	....	20	70	3	4	11	119
Floor or roof collapse	....	....	....	....	1	11	5	....	....	17
Miscellaneous deficiencies	....	....	....	....	....	3	....	....	....	3
Obstruction to distribution										
Fires under benches, etc.	....	....	....	....	....	88	5	1	1	95
High piling of stock	....	....	....	....	2	54	22	....	1	79
Partitions erected	1	....	....	....	3	11	2	1	1	19
Miscellaneous reasons	....	....	....	....	....	7	1	....	....	8

Table No. 9 (Continued)

	Residential	Assembly	Institutional	Offices	Mercantile	Manufacturing	Storage	Miscellaneous Occupancies	Multiple Occupancies	Total
Hazard of occupancy										
Hazard too severe for sprinkler equipment as installed	.....	.....	.....	.....	2	133	10	7	2	154
Explosion damaged system	1	.....	.....	1	1	93	10	8	2	116
Water overflowed containers of flammable liquids	.....	.....	1	.....	1	12	.....	.....	.....	14
Miscellaneous reasons	.....	.....	.....	.....	.....	4	.....	.....	.....	4
Exposure fire										
Exposure fire overpowered sprinkler system in exposed building	.....	1	.....	.....	1	33	6	2	.....	43
Inadequate maintenance										
Plugged sprinklers	.....	1	.....	.....	1	24	1	.....	.....	27
Sprinklers dirty, corroded or coated	.....	.....	.....	.....	1	33	2	2	.....	38
Obstructed piping	1	1	.....	.....	3	90	15	3	.....	113
Defective check valve	.....	.....	.....	.....	.....	1	.....	.....	.....	1
Miscellaneous reasons	.....	.....	.....	1	.....	4	.....	.....	.....	5
Antiquated system										
Pipe sizes, sprinkler spacing sub-standard or old-standard	2	1	.....	.....	1	47	4	.....	.....	55
Valves sub-standard or old-standard	.....	.....	.....	.....	.....	1	.....	.....	.....	1
Sprinklers sub-standard or old-standard	.....	.....	1	1	.....	2	.....	1	.....	5
Miscellaneous deficiencies due to age	.....	.....	.....	.....	.....	.....	.....	1	.....	1
Miscellaneous and unknown										
Causes of unsatisfactory sprinkler performance unknown or cannot be otherwise classified	.....	.....	.....	.....	.....	38	2	2	.....	42
Total	20	35	7	7	95	1723	212	112	44	2255

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someone puts the fire out with an extinguisher or small hose line. There are some slight variations in the reporting practices of different cooperating organizations, but these have no significant effect upon the tables.

It should be noted that these tables reflect only efficiency of operation, and are only indirectly related to the amount of fire losses. For example, where sprinklers do not operate because the water is shut off unsatisfactory performance is recorded, even though the fire may have been promptly discovered and extinguished by normal means with small loss.

Grateful acknowledgment is made to the various organizations and individuals who have submitted the large volume of fire reports that permit this analysis.

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Waterflow alarms, caused by fires or serious leaks.....2,994
Manual fire alarms.....115
Reported values of properties protected.....$15,876,633,000
Ratio of losses to values protected.....2/100ths of 1%
Fire-loss immunity in 1954.....99-98/100ths %

AVERAGE FIRE-LOSS IMMUNITY DURING THE PAST TEN YEARS 99 98/100 %

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Investigations of failures of watchmen to signal Central Station on schedule 206,875
Total number of signals recorded.....314,502,496
Watchmen's patrol efficiency.....99-93/100ths %
Alarms from Manual Fire Alarm Boxes.....1,362
Reported values of properties protected.....$18,907,278,000
Ratio of fire losses to values protected.....2/100ths of 1%
Fire-loss immunity in 1954.....99-98/100ths %

AVERAGE FIRE-LOSS IMMUNITY DURING THE PAST TEN YEARS 99 96/100 %

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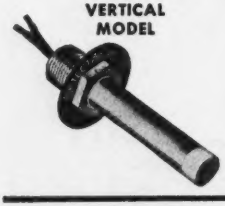

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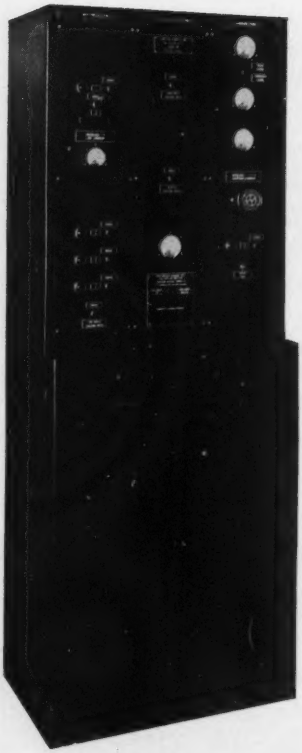
Type CM and CA McCulloh Central Office Control Units approved by Underwriters' Laboratories, Inc. and Associated Factory Mutual Fire Insurance Companies.

Designed to comply with Federal specification WF 396 A.



TYPE CM

Manually Operated Control Unit

Designed to operate a complete central office shunt McCulloh fire alarm system consisting of fire alarm stations, automatic transmitters, gongs, and register equipment as required.

TYPE CA

Automatically Operated Control Unit

The Acme type CA automatically operated Main Control Unit is identical to the type CM with the exception that all functions of the unit, except the charging, are automatically controlled, making it unnecessary for anyone to operate the system if an open or ground fault occurs on the box circuit. The Control Unit will automatically adapt itself to these fault conditions and normal transmission of signals will continue.

ACME FIRE ALARM CO., INC.

106 Seventh Avenue

New York City, N.Y.

VICTAULIC

VICTAULIC COUPLINGS

Styles 77, 77-D for standard applications. Simple, fast to install—sturdy and reliable. Sizes ¾" to 30". Style 75 Light-Weight Couplings for light-duty applications. Sizes 2", 3", 4". Additional styles for cast iron, plastic and other pipes. Sizes through 60".

ROUST-A-BOUT COUPLINGS

Style 99 for plain or beveled end pipe. Best engineered, most useful plain end joint on the market. Simple, husky — easy and fast to install. Takes strong bull-dog grip on pipe. Sizes 2" to 8".

VICTAULIC FULL-FLOW FITTINGS

Complete line of Elbows, Tees, Reducers, Laterals, etc. — to fit all Victaulic Couplings. Streamlined for top efficiency, easy to install. Sizes ¾" to 12".

VIC-GROOVER TOOLS

Handy, on-the-job grooving tools that do the job in half the time. Light weight, easy to handle — operate manually or from any power drive. Automatic groove position and depth. Sizes ¾" to 8".

APPROVED BY:

Factory Mutual

New York City Board of Standards and Appeals, Cal. #413-53-SM.

Underwriters' Laboratories, Inc.

Proven for 26 years **on both wet and dry Fire Protection Systems. Standard with most major sprinkler companies for bulk-run and cut-in piping. Victaulic Couplings are installed in *less than one-half the time* required for other standard pipe joints.**

THE EASIEST WAY TO MAKE ENDS MEET

VICTAULIC

COMPANY OF AMERICA

P.O. Box 509, Elizabeth, N. J.

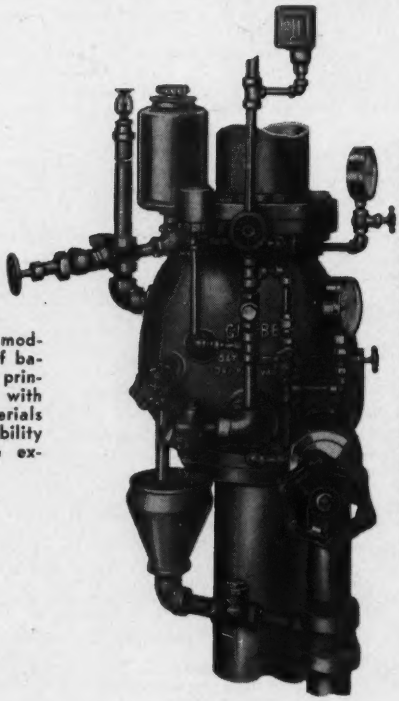
ANOTHER

GLOBE SAVEALL DEVICE

Dry Pipe Valve Model "F"

MODERN

represents the modern application of basic engineering principles balanced with high quality materials insuring durability over a long life expectancy.



COMPACT

The well known principles of differential and mechanical leverage for retaining the service water pressure from entering the system with reasonably low air pressures in the piping combined in a single air and water retaining clapper assembly, permits the minimum number of operating parts built within a removable unit, which simplifies the setting and maintenance procedures and insures positive performance within the ratio limits without pre-water leakage.

APPROVED BY ALL INSURANCE AUTHORITIES

Manufactured in 4" and 6" Size

Manufactured and Installed By

GLOBE AUTOMATIC SPRINKLER COMPANY

PHILADELPHIA, PA.

OFFICES IN PRINCIPAL CITIES

HORTON WATERSPHERE

Protects Pen Company Plant From Fire

W. A. Sheaffer Pen Company installed the 75,000-gallon Horton Watersphere shown above to provide dependable gravity water pressure for the sprinkler system at its plant in Fort Madison, Iowa.

Founded in 1913, the Sheaffer Pen Company first occupied a small building adjacent to the present plant, a modern $3,500,000 structure built in 1952.

The automatic sprinkler system has 1,800 sprinkler heads and protects the 172,000 square feet of manufacturing area. The Fort Madison city water main serves as the primary water supply and the Watersphere provides the secondary water supply for the sprinkler system.

Waterspheres are available in standard capacities from 25,000 to 250,000-gallons.

Close-up of 75,000 Gallon Watersphere.

CHICAGO BRIDGE & IRON COMPANY

ATLANTA	CHICAGO	LOS ANGELES	SALT LAKE CITY
BIRMINGHAM	DETROIT	NEW YORK	SAN FRANCISCO
BOSTON	HOUSTON	HAVANA	PHILADELPHIA
CLEVELAND	SEATTLE	PITTSBURGH	TULSA

Plants at Chicago, Birmingham, Salt Lake City and Greenville, Pa.

There is no need
Ansul's complete fire

Experience can be a grim teacher. It has taught many a businessman that you need a *complete* fire protection program to guard against ruinous fire damage. You need *fast, effective equipment,* plus *trained personnel* to man that equipment. Ansul offers *both* and at no extra cost. Get in touch with the Ansul man, he has the story about *complete* fire protection.

to accept less than protection program!

TRAINING DEMONSTRATIONS. Our fire fighting experts provide training in the use of Ansul equipment at your plant.

ALL ANSUL EQUIPMENT is backed by a five year warranty, your assurance of fast, effective fire protection.

Call the Ansul Man!

Get in touch with your local Ansul man through the "yellow pages" or write ANSUL CHEMICAL COMPANY, Dept. F-22, Fire Equipment Division, Marinette, Wisc. Write Ansul for your copy of new Fire Equipment Catalog.

ANSUL

BRAND-NEW FIRE KILLER!

"WOW- trigger release for fast action!"
"HEY- pistol grip for easy handling!"
"SEE- new dust and moisture-proof gauge shows pressure at a glance!"
"BOY- powder won't pack, can't clog extinguisher!"
"LOOK- diffuser horn gives wider coverage in any position!"
"SAY- has reinforced bottom, won't topple over!"
Kidde

Leave it to Kidde to come up with a red-hot idea like this—a big, new 10-pound dry chemical extinguisher effective at *any* pressure from 150 to 250 pounds!

Naturally, this new Kidde 10-pounder has all the features that make the Kidde line second to none—fast action, easy handling, simple trigger operation, and extra-wide coverage that snuffs out fire in seconds. But the "wide operating range" feature makes the 10-pounder a *real* standout!

Unlike other extinguishers, which usually operate at one pressure only, the Kidde 10-pounder works through an extremely wide pressure range. Even when charged to 150 pounds, the Kidde 10-pounder is UL-approved for Class B and C fires. Boost the charge to *250* pounds, and you have an extinguisher with *extra* hard-hitting punch!

For fighting fires in deep-burning liquids, electrical machinery and other hard-to-get-at places, *nothing* beats a Kidde Dry Chemical Extinguisher. Good for fires in textiles, too! Learn more about Kidde protection. Write Kidde today!

Walter Kidde & Company, Inc.
451 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

Kidde

The words 'Kidde', 'Lux', 'Lux-O-Matic', 'Fyre-Freez' and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

The building that died of thirst

This fire would have been quickly controlled and the building saved had it had an automatic Rockwood sprinkler system. Instead, it was unsprinklered. Result: a $1,500,000 property damage, including valuable records that are gone forever, loss of jobs for all employees, loss of customers now forced to seek a new source of supply.

Many buildings face the same peril. Fortunately, this can be remedied easily. What's more, a new type of Rockwood WaterFOG Sprinkler Head now brings amazing Rockwood WaterFOG to conventional sprinkler systems, making them more effective than ever.

The new Head, which covers 30% more area than ordinary heads, is a result of years of research by Rockwood engineers working closely with engineers in the U. S. Navy, municipal fire departments and industry. The Head sprays water into millions of particles which burst into a blanketing mist. This mist cools the temperature, covers nearby flammables and smothers the fire. For complete information, send coupon.

ROCKWOOD
SPRINKLER COMPANY

ROCKWOOD *Engineers Water.. to Cut Fire Losses*

SEND FOR THIS INFORMATIVE BOOKLET

ROCKWOOD SPRINKLER COMPANY
244 Harlow Street, Worcester 5, Massachusetts

Please send me the 12-page illustrated booklet, "15 Types of Fire Protection," giving actual case histories of different types of fire control.

Name_____

Title_____

Company_____

Street_____

City_____ Zone_____ State_____

RELIABLE SPRAY SPRINKLER

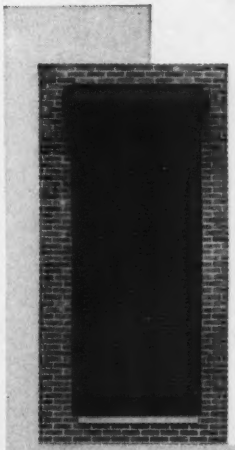
- Greater Coverage!
- Lower Ceiling Temperatures!
- Faster Cooling of Hot Fire Gasses!
- Better Fire Extinguishment with Less Water!
- Fewer Sprinklers Operating Adjacent to Fire Area!

Incorporating the new principle of water distribution, the Model "C" Spray Sprinkler is another example of Reliable's leadership in new product design. All Reliable Sprinkler Devices are the assurance of the ultimate in fire protection . . . and have been protecting life and property for over 30 years! Reliable Sprinkler Devices are distributed . . . installed and serviced by Reliable's chain of licensed representatives located throughout the United States, Canada and foreign countries. A Reliable representative is as near as your phone. . . . Call him for a system designed to your specific needs!

Constant Fire Protection That's Always "Reliable"!

THE RELIABLE AUTOMATIC SPRINKLER CO. INC.

Automatic Rolling Steel
FIRE DOORS *and* WINDOW SHUTTERS
PREVENT SPREAD *of* FIRE!



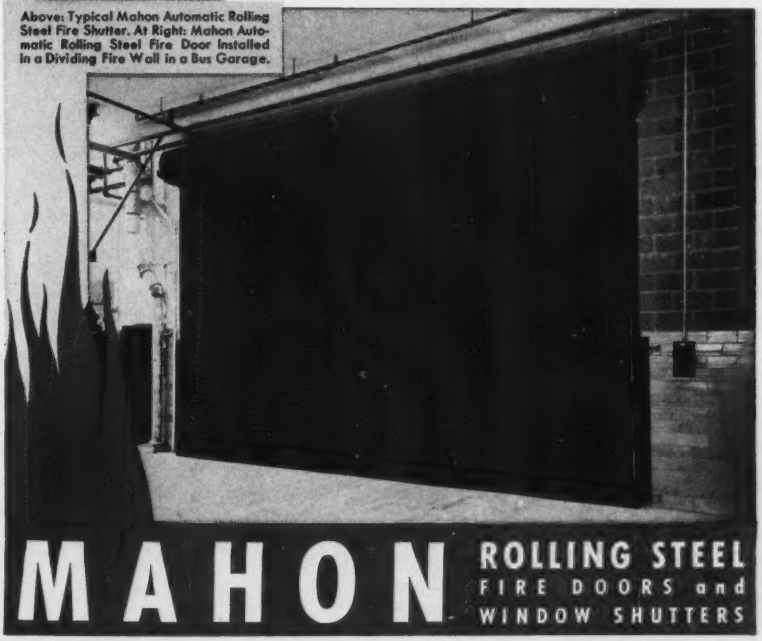
You need good automatic fire doors in fire walls, corridors, and vertical shafts . . . in some cases automatic rolling steel window shutters are necessary to protect your building and its contents from fires which may originate in nearby buildings. Many, many cases are on file which confirm that timely action of automatic rolling steel fire doors and window shutters have confined a fire to its point of origin and permitted its being extinguished with comparatively small damage. Make a survey of your building now, and don't delay action. You will find a Mahon Automatic Rolling Steel Fire Door or Window Shutter to meet each of your requirements—all bear the Underwriters' Label. These automatic fire doors may be operated manually or mechanically in every day use. If a fire should break out while they are in the open position, the automatic mechanism will close the door, cutting off drafts and preventing the spread of the fire. See Sweet's Files for complete information, or write for Catalog G-55.

THE R. C. MAHON COMPANY

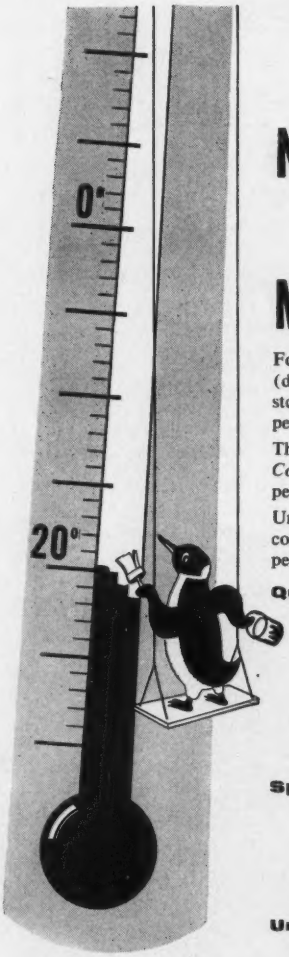
Detroit 34, Michigan • Chicago 4, Illinois

Manufacturers of Automatic Rolling Steel Fire Doors and Window Shutters. Also Many Types of Standard General Service Rolling Steel Doors and Grilles, Insulated Metal Walls, and Steel Deck for Roofs, Floors and Partitions.

Above: Typical Mahon Automatic Rolling Steel Fire Shutter. At Right: Mahon Automatic Rolling Steel Fire Door Installed in a Dividing Fire Wall in a Bus Garage.



MAHON ROLLING STEEL FIRE DOORS and WINDOW SHUTTERS



important advance in year-round fire protection

NEW 3% AER-O-FOAM LIQUID MAINTAINS MOBILITY AT –20°F

For control of fires in flammable liquids, 3% foam liquids (double strength) offer obvious advantages: economy of storage space, facility in transport and handling, low cost per unit volume of foam.

The new, patented National *AER-O-FOAM Liquid, 3% Cold Foam,* combines these advantages with the ability to perform as well at sub-zero temperatures as at summer heat.

Unique in its field, this new AER-O-FOAM Liquid assures correct proportioning in the foam-making process at temperatures as low as –20°F. The extra protection is apparent.

Quick facts on performance

National AER-O-FOAM Liquid, 3% Cold Foam, is equally effective with soft, hard, or sea water.

It stores easily for longer periods because there is no deterioration under normal storage conditions.

It is compatible with almost all 3% regular liquids.

It meets all applicable requirements of U. S. Government specifications.

Special Cold-Weather AER-O-FOAM Trucks

For use with 3% Cold Foam Liquid, National Foam offers special foam trucks insulated for operation in very low temperatures. Carrying up to 750 gallons of 3% Cold Foam Liquid, the trucks can produce as much as 12,000 gallons of foam per minute.

Unlimited supply

As a result of recent expansion in National Foam's production facilities, the new 3% Cold Foam Liquid is available in unlimited quantities. Full details will be forwarded promptly on request.

NATIONAL FOAM

SYSTEM, Inc.
West Chester, Pa.

World's Fastest Fire Detector

. . . sees fire with the speed of light

. . . instantly actuates alarm or extinguishing systems

. . . a single system protects up to 200,000 square feet

. . . makes outdoor protection practical for the first time

For greatest fire protection, you need instant fire detection . . . and only Fireye can give it to you.

This proved device sees the flame when it first flickers. It doesn't wait for smoke or heat to indicate a fire already out of control.

For further information about Fireye — the world's fastest fire detector — send coupon below.

fireye DIVISION

E C A

Electronics Corporation of America
Dept. F26-4
77 Broadway, Cambridge 42, Massachusetts

Please send me your new descriptive bulletin, "Fireye . . . the new standard in fire detection."

Name.....

Company.....

Address.....

ROLAGRIPS

for plain end pipe, 1½" to 12". No threading, grooving, flanging or welding.

fast, flexible, low cost sprinkler system couplings

GRUVAGRIPS

for jobs specifying ¾" to 14" grooved pipe. Double rib construction gives great strength with least weight.

ROLAGRIPS and GRUVAGRIPS are listed for use in sprinkler systems by Factory Mutual and Underwriters' Laboratories. Their simple construction makes installation a snap. Just three parts — twin housing halves and synthetic rubber gasket — held by two bolts. Re-usable. ROLAGRIPS and GRUVAGRIPS are leakproof under working pressures to 1,000 psi, end pull to 102,000 pounds. They automatically absorb shock, vibration, deflection to 7°, expansion and contraction.

Write today for prices and new free illustrated couplings folder 55-F. Or see ROLAGRIPS and GRUVAGRIPS (and companion GRUVAGRIP FITTINGS) at your supply store.

GUSTIN-BACON MANUFACTURING CO.

210 West 10th Street Kansas City, Missouri

The AMAZING New

Star Spray Sprinkler!

(MODEL C—UPRIGHT)

With its

Unequalled Performance

Gives You . . . . . .

SUPERIOR PROTECTION — revolutionary in method — for any type of occupancy — no matter how severe the hazard . . . . . with

LESS WATER USED — more effectively and more efficiently — for total extinguishment and cooling. . . . All water discharged goes directly on the fire — not on the ceiling. . . . Ceilings are so cooled that no sprinkler will open unnecessarily. . . . . .

STAR SPRAY SPRINKLERS — the ultimate in modern fire protection — can replace former-type sprinklers without changes in piping. . . . . Available for installation in either **UPRIGHT** or **PENDENT** position.

Approved by Factory Mutual Laboratories
Listed by Underwriters' Laboratories, Inc.

Write for name and address of STAR licensed contractor nearest your location, to:

STAR SPRINKLER CORP.

Westmoreland and Collins Sts. — Philadelphia 34, Pa.

Licensees in all Principal Cities of the United States and Canada

ALL TYPES...ANY CLASS FIRE!

Since different fire hazards require different types of fire extinguishers, PYRENE—C-O-TWO manufactures all types...the finest and most complete line on the market today.

When doing business with PYRENE—C-O-TWO, you receive unbiased advice on what is best for your particular fire hazards, whether class A, B or C. Also, there is a well-rounded sales engineering organization having nation-wide representation to render top quality service wherever you're located.

Don't take unnecessary chances ... the extensive fire protection experience of PYRENE—C-O-TWO over the years is at your disposal without obligation. Get complete facts now!

Pyrene **PYRENE — C-O-TWO** C-O-TWO

NEWARK 1 • NEW JERSEY

Sales and Service in the Principal Cities of United States and Canada

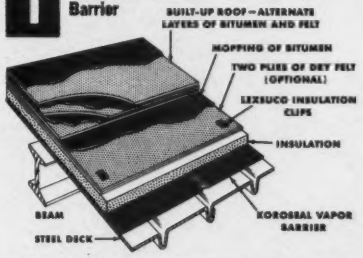
COMPLETE FIRE PROTECTION

portable fire extinguishers... built-in fire detecting and fire extinguishing systems

CARBON DIOXIDE • DRY CHEMICAL • VAPORIZING LIQUID • SODA-ACID • WATER • CHEMICAL FOAM • AIR FOAM

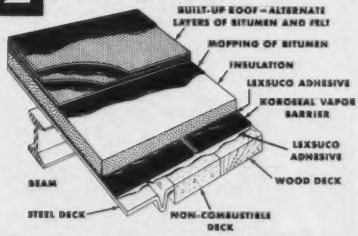
5 LEXSUCO *FIRE-SAFE* ROOFS

1 Over steel deck . . . Koroseal Vapor Barrier



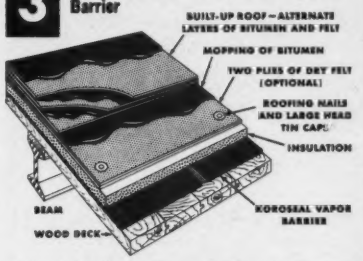
● *fire-retardant* ● *uses Lexsuco Clips*

2 Over steel, concrete or wood deck . . . Koroseal Vapor Barrier



● *fire-retardant* ● *uses Lexsuco Adhesive*

3 Over wood deck . . . Koroseal Vapor Barrier



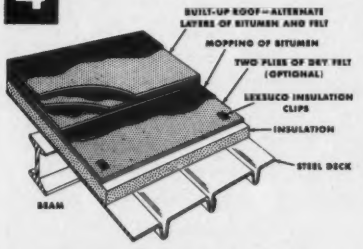
● *fire-retardant* ● *uses nails and tin caps*

At no more cost than conventional roofing, these five new Lexsuco Roof Designs fill the need for superior industrial and commercial roofs having greater fire resistance. Utilizing standard built-up roofing materials, they can be applied over any type deck.

Outstanding features of these designs are: Koroseal Vapor Barrier—the tough elastic sheeting that is highly resistant to vapor transmission and does not support combustion; Lexsuco Clips and Lexsuco Adhesive—the modern, fire-safe devices which provide high-strength fastening of Koroseal Vapor Barrier and/or insulation to decks.

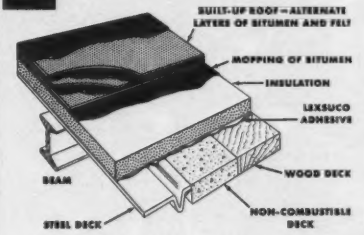
For all your built-up roofing applications, specify "Lexsuco Roof Constructions".

4 Over steel deck . . . no vapor barrier



● *fire-retardant* ● *uses Lexsuco Clips*

5 Over steel, concrete or wood deck . . . no vapor barrier



● *fire-retardant* ● *uses Lexsuco Adhesive*

To get further details on these Lexsuco Roof Designs, see our catalog in Sweet's Architectural and Industrial Construction File.

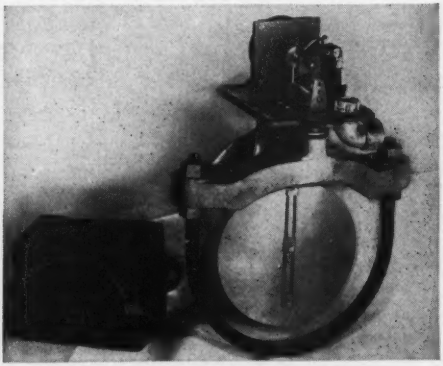
LEXSUCO

CLEVELAND 3, OHIO

CENTRAL STATION SIGNALS, INC.

Manufacturers of all kinds of approved devices used in Central Station Systems or Class 'A' or Class 'B' Proprietary Fire Alarm Systems, either automatic or manual.

53 West 23rd STREET . . . . . NEW YORK 10, N. Y.



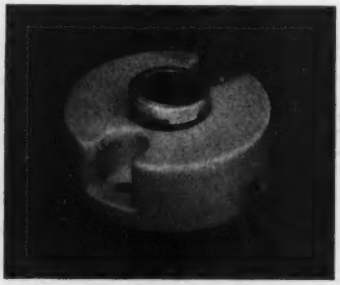
5-inch size shown above. To install simply drill 2-inch hole in pipe.

Model PRS-1
Sprinkler
Waterflow Alarm

This device is approved by Factory Mutual Laboratories and Underwriters' Laboratories, Inc.

- This device is also made as Model PRT-1, a coded waterflow transmitter.

- Also made in explosion proof models.
- Made in all sizes from 2½" to 8".
- Has instantly recycling pneumatic retarding device, which prevents false alarms.
- Has enclosed electrical contacts for 15 amp. 125 volts, A.C. and ½ AMP, 125 volts, D.C.



Size is 1⅝" x ⅝"

Tempo-Set Model A
Fire Detector

Underwriters' Laboratories, Inc. Approved.

- Self restoring and can be heat tested.
- Electrical contacts are silver or gold and are enclosed.
- Very reasonable price.

- Tempo-set Model A is approved in either open or closed circuit and the temperature ratings are 140 and 200 degrees.
- Approved spacing is 20' x 20'.
- Electric ratings are 125 volts 1 ampere, A.C. or 24 volts 0.5 ampere D.C., or less.

DO YOU GET THIS KIND OF FOAM

from your AIR FOAM System?

This photomicrograph is the revealing secret of **NICEROL** *AIR FOAM'S TRULY AMAZING heat stability*

SPECIAL TESTING OFFER

Simply write the one word "SAMPLE" on your official stationery and we will send to you: Freight pre-paid, anywhere in the U.S.A. or Canada, one 5-gallon can of NICEROL Double strength Air Foam Liquid, for $20 C.O.D. (or please enclose check). Test this sample can through your existing foam system—to produce 1,650 gallons of tough foam from only 165 gallons of water, fresh or salt.

The $20 cost of this sample will be deducted from your first order for NICEROL of 100 gallons and over.

THIS IS WHY *NICEROL*
GIVES GREATER HEAT RESISTANCE

The minute, closely-knit bubbles retain the maximum water content in a foam that is both adhesive and cohesive. This is the reason that Air Foam, made from Nicerol, defies fire breakdown, puts out more fire faster, and definitely outlasts the fire to prevent flashbacks.

NICEROL Air Foam Liquid lasts longer in the can, too, because it is specially processed to prevent corrosion of cans and containers—nor does it form sludge.

NICEROL Air Foam Liquid can be used with all approved types of air foam systems and nozzles.

NICEROL is more widely used throughout the world than any other air foam liquid.

Nicerol

THE LONGER LASTING AIR FOAM

Keeps longer in storage—Puts out more Fire Faster
Outlasts the Fire

INQUIRIES INVITED FROM DISTRIBUTORS AS WELL AS USERS. FULL TECHNICAL AND COMMERCIAL DETAILS AVAILABLE FROM

GEORGE T. REYNOLDS & ASSOCIATES, P.O. BOX 395, THORNWOOD, N.Y., U.S.A.

BRITISH FIRE EXTINGUISHERS LTD., 222 SIMCOE ST., TORONTO 2B, ONT., CANADA

NOTIFIER AUTOMATION REVOLUTIONIZES

• FIRE DETECTION . . .

• SPRINKLER SUPERVISION . . .

• WATCHMAN SERVICE

Here's the NOTIFIER record

1954—Rapid Advancement to the position of a leader in automatic fire detection.

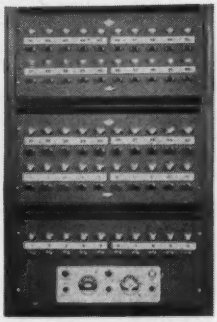
1955—AUTOMATION introduced to the fire detection and sprinkler supervision field.

Human mistakes *eliminated* by immediate detection, notification, and permanent recording of alarms. 100% AUTOMATIC—important NOTIFIER development.

UNBELIEVABLE new developments now under way in our factory.

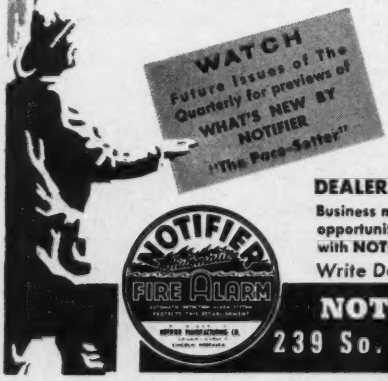
Safety engineers and plant managers are invited to write for 40-page illustrated booklet on fire detection and sprinkler supervision and maintenance.

Consult our engineering staff on your fire prevention program.



Current UL and FM Listings

Local detection systems
Auxiliary detection systems
Local sprinkler systems
Auxiliary sprinkler systems
Remote (fully supervised) control fire station receiving panel
Automatic code selector
Two or three-wire power supply
Combination relay units
Annunciators
Tripping devices
Manual alarm systems
Notifier thermostats
Vibrating bells



DEALERS WANTED:

Business men, salesmen and fire engineers—a unique opportunity to establish yourself in your community with NOTIFIER.

Write Dept. Q-5

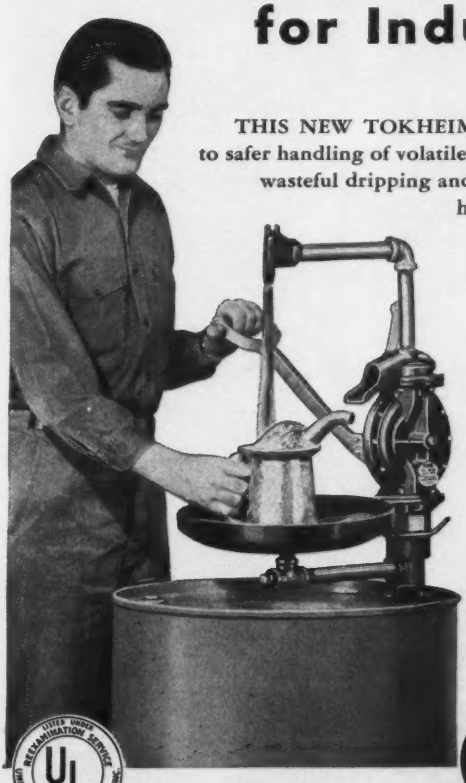
NOTIFIER FIRE ALARM

NOTIFIER MFG. CO.

239 So. 11th Lincoln, Nebr.

SAFER

liquid handling for Industry



THIS NEW TOKHEIM HAND PUMP contributes to safer handling of volatile liquids wherever used. Stops wasteful dripping and slippery floors. Reduces fire hazard and accidents common to other methods of liquid transfer. Approved for handling petroleum liquids —ideal for many others. Available in 22 different models for 'most any use— from pipe lines to drums, or underground tanks, with hose or spout outlets. Order from your dealer, your oil company, or your Tokheim representative.

Write factory for literature.

QUALITY TOKHEIM HIGH VACUUM HAND PUMPS

General Products Division

TOKHEIM CORPORATION

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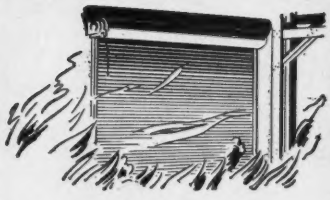
"Akbar"—the famous Kinnear Rolling Fire Door



Automatically BLOCKS the Spread of fire

Safety Features Give Building Occupants EXTRA Protection

You get *positive, automatic* fire protection at doorways, windows and other openings with Akbar Fire Doors. They're *pushed* downward by a strong spring . . . *controlled* in downward speed by a special safety device . . . and operable in emergency *after* automatic closure. Coiled out of the way overhead when not in use, they lower quickly into place when fire threatens, cutting off drafts and confining flames to small areas. Approved by Underwriters' Laboratories, they are built in any size. Kinnear Rolling Fire Doors can also be equipped for daily service with motor or manual operation. (Non-labeled Kinnear Rolling Doors are preferred for service use where maximum fire protection is not required.) Write!

The KINNEAR Manufacturing Co.

Factories: 2250-70 Fields Ave., Columbus 16, Ohio; 1742 Yosemite Ave., San Francisco 24, Cal.

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KINNEAR ROLLING DOORS

GRIMES

AUTOMATIC
Spray
SPRINKLERS

UPRIGHT
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SPRINKLERS — ALL TYPES AND FINISHES
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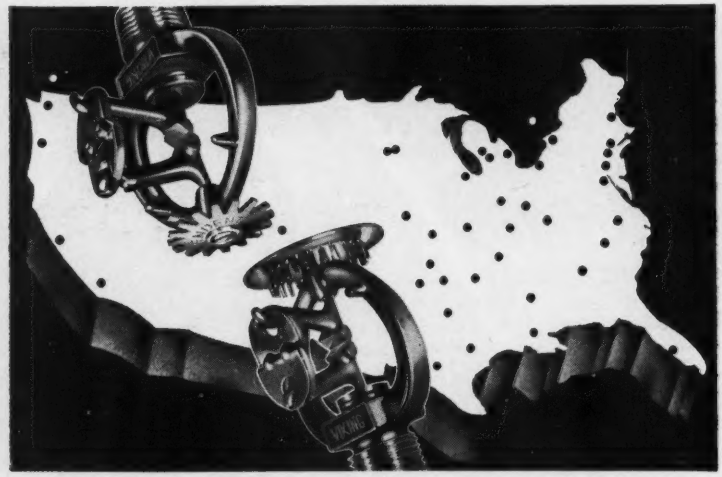

VIKING SPRINKLER FIRE PROTECTION

for any condition whatever it happens to be!

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the VIKING corporation

HASTINGS, MICHIGAN

Report on

SHEETROCK* FIRECODE 60

What it is: SHEETROCK Firecode 60 gypsum wallboard is 5/8-inch SHEETROCK with a specially formulated core of gypsum and other incombustible materials. It was developed by U.S.G. to meet rigid code requirements in single layer application for new construction or remodeling.

What it does: SHEETROCK Firecode 60 has received the One-Hour Fire Retardant Classification Label of Underwriters' Laboratories for:

A. Conventional wood stud partitions faced each side with 5/8" SHEETROCK Firecode 60.

B. Conventional wood floor and ceiling constructions with ceiling surfaced with SHEETROCK Firecode 60 Gypsum Wallboard.

C. **New**—Steel joist and concrete Floor Construction, protected with ceiling of SHEETROCK Firecode 60, having either taped or untaped joints; various methods of attaching SHEETROCK Firecode 60 to steel joists.

SHEETROCK Firecode 60 has received a 2-hour Fire Retardant Classification Label of Underwriters' Laboratories for:

Conventional wood stud partitions faced each side with two layers of SHEETROCK Firecode 60 Gypsum Wallboard.

New—Flame Spread rating. A fire hazard classification rating of 10 to 15 is now applicable to this product.

You can recommend and approve SHEETROCK Firecode 60 with full assurance that this product is made to the high quality standards for which U.S.G. products are famous.

For complete data and specifications for erection, consult your local U.S.G. Architects' Service Representative, or write United States Gypsum, 300 W. Adams, Chicago 6, Ill.

*T. M. Reg. U. S. Pat. Off.

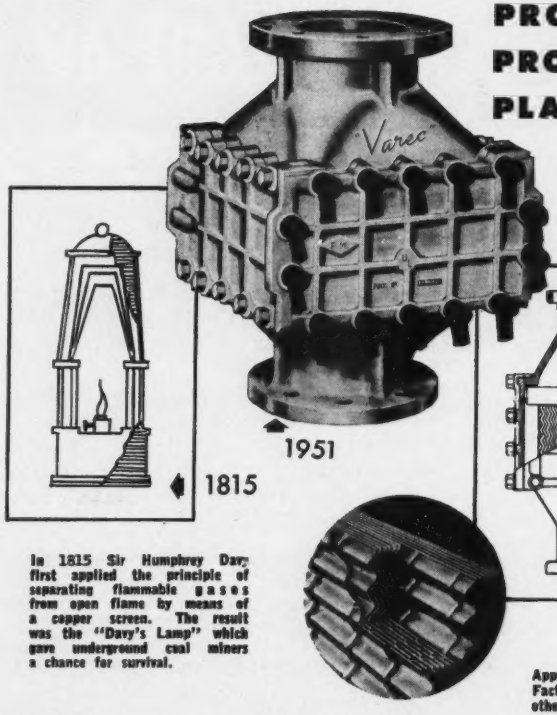
UNITED STATES GYPSUM The Greatest Name in Building

Chicago 6, Illinois

THIS MODERN

"Davy's Lamp"

PROTECTS PROCESSING PLANTS



In 1815 Sir Humphrey Davy first applied the principle of separating flammable gases from open flame by means of a copper screen. The result was the "Davy's Lamp" which gave underground coal miners a chance for survival.

"VAREC" Fig. No. 50 Flame Arrester Listed by Underwriters' Laboratories Approved by Associated Factory Mutuals Laboratories and other governing agencies

"VAREC" FLAME ARRESTERS utilize this age-old basic principle of heat transfer in protecting plants, equipment and lives against fire and explosion wherever gas or flammable liquids are stored.

They stop burning gas in piping from rapidly propagating thus preventing fire and explosion. Heat of the flame is dissipated through the many surfaces of the multiple corrugated aluminum plates within the unit. Resultant heat loss, plus the tortuous passageways through which the flame would have to pass, stops flame propagation just as the copper screen did in the "Davy's Lamp."

"Varec" Flame Arresters are a low cost investment in the utmost safety for your plants . . . consult your "Varec" representative or write direct.

NF 2

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Cable Address: VAREC COMPTON USA (All Codes)

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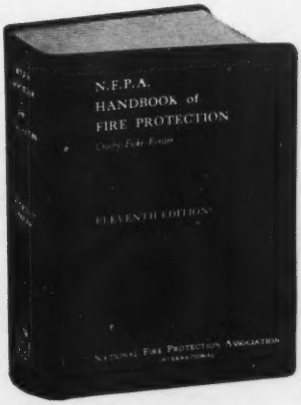

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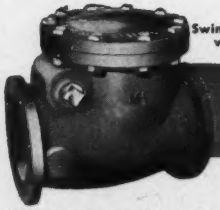
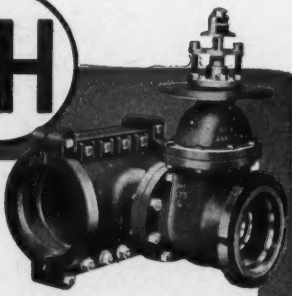

Swing Check valve.

M H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We make a complete line of Valves, Hydrants, Indicator Posts and underground pipe fittings for fire protection systems. All M & H products are approved and listed by the Underwriters' Laboratories and A. F. M. Laboratories. Outstanding features are simplicity of design, rugged construction and highest quality materials and workmanship. Write for CATALOG No. 52. On your orders specify M & H for service.

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—in a single storage unit

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ELEVATED STEEL TANKS

100,000-gallon P-DM dual service elevated steel tank at Hartford Special Machinery Co., Simsburg, Conn.

Combining 25,000 gallons of water storage for regular use with a fixed reserve of 75,000 gallons for sprinkler demand, this 100,000-gallon Pittsburgh-Des Moines Double-Ellipsoidal Elevated Steel Tank is of a type and size widely favored by industrial plants, hospitals, institutions and smaller communities.

The tank and its 100-foot tubular column tower are of welded construction. The pleasing appearance of the unit results from balanced, functional design; it is standardized throughout for maximum dollar value to the purchaser.

Write for our complete Elevated Tank Catalog, free on request.

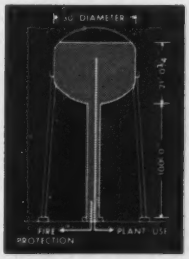

Diagram illustrates plant-use storage down to 75,000 gallon level. Balance of tank and riser capacity reserved for fire protection only, supplying automatic sprinkler system.

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The Shand & Jurs HYDRAFOLD valves and INTERNAL SAFETY valves go hand in hand like Pat and Mike. But it's no joke how they provide maximum efficiency in the discharge of truck tank contents The S&J HYDRAFOLD valves enable just one meter to serve several tank compartments through a manifold. These valves and corresponding INTERNAL SAFETY valves are selected and operated simultaneously by the S&J Operator. Both the HYDRAFOLD and INTERNAL SAFETY valves are normally held closed by spring pressure and can be opened only by the time proven, dependable hydraulic pressure system. Tiny fusible plugs which melt at 165° F. are located strategically in the hydraulic lines. Should fire endanger the truck tank or contents the plugs will melt releasing hydraulic pressure and allowing both the HYDRAFOLD and INTERNAL SAFETY valves to close instantly. Designated by S&J as Fig. 13050, these HYDRAFOLDS are available in 3" and 4" sizes. Another model, Fig. 13930 is available in the 2" and 3" sizes.

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this "ounce" of protection...

is worth ten times its capacity in fire hose

A single Blaw-Knox Spray-Head, shooting its quenching spray of water right into the very heart of a starting fire, can accomplish more than several hose streams each having ten times its capacity.

The Blaw-Knox Spray-Head, protecting you around the clock, puts water to work wherever and whenever needed. Its finely divided spray, directed in the most effective pattern, provides much greater fire control with less water.

Multiply this kind of fire fighting efficiency in a system engineered to guard against your specific hazard and you are assured of a maximum of protection.

No cash outlay is required and the system will pay for itself in reduced insurance premiums within a few years. Let a Blaw-Knox Fire Protection Engineer study your needs and submit an estimate . . . absolutely without obligation.

Blaw-Knox fire protection systems carry approvals of all insurance underwriters

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You'll be interested in the new Blaw-Knox booklet, **"Fire Can Destroy Your Business."** There's no charge. Write for it.

"Little Joey Sprinkler" always on the job

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Get your exits

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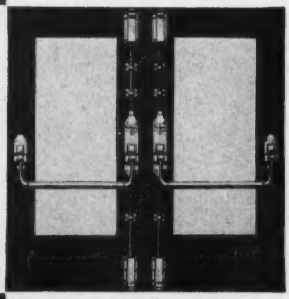

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"EXIT SPECIALIST"

● Increased production for your plant means more employes, more traffic, more need than ever for safe, dependable exits. Call in your Von Duprin "Exit Specialist" for a free survey of your exit requirements. From actual experience, he can recommend the right Von Duprin exit devices to give you the greatest safety and service. Von Duprin is the most complete line of approved exit devices. From this one line, you can meet *all* your present and potential exit hardware needs. If you don't know the name of your nearest "Exit Specialist," write Von Duprin.

FREE Reserve a showing of Von Duprin's 20-minute sound movie, "Safe Exit." Build a lively safety program around this interesting public service film. Write for a booking.

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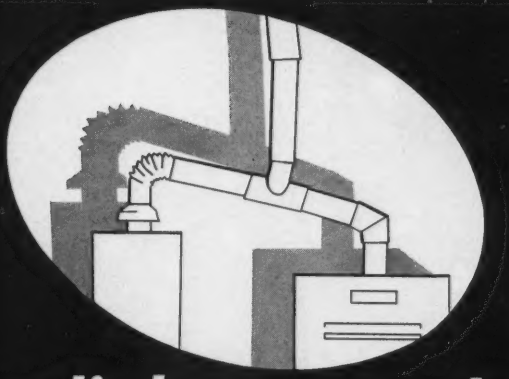
Von Duprin Fire and Panic **EXIT DEVICES**

THE SAFE WAY OUT!



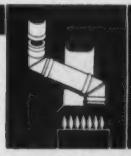
spotlight on trouble

Most of you can tell at a glance what's wrong with this installation. Yet how many times have **insufficient** vent connector rise . . . improper combined vents . . . and **inadequate** single-wall pipe been the rule rather than the exception. And the property damage, unhealthy conditions and costly vent repairs that often result, **reflect unfavorably on the whole gas industry.**

Crusade for Correct Venting

Spotlighting such trouble zones is a current Metalbestos promotion project — part of a continuing campaign to rectify vent installation habits harmful to the gas heating business. It hammers home the demonstrated fact based on extensive research by William Wallace Company and on generally accepted principles, that **double-wall insulated gas vent pipe is absolutely basic to proper venting procedure.**

Only when this fact is established with all those concerned with gas heating and venting, can the gas industry expect complete acceptance for the products and services they have to sell.



METALBESTOS DIVISION

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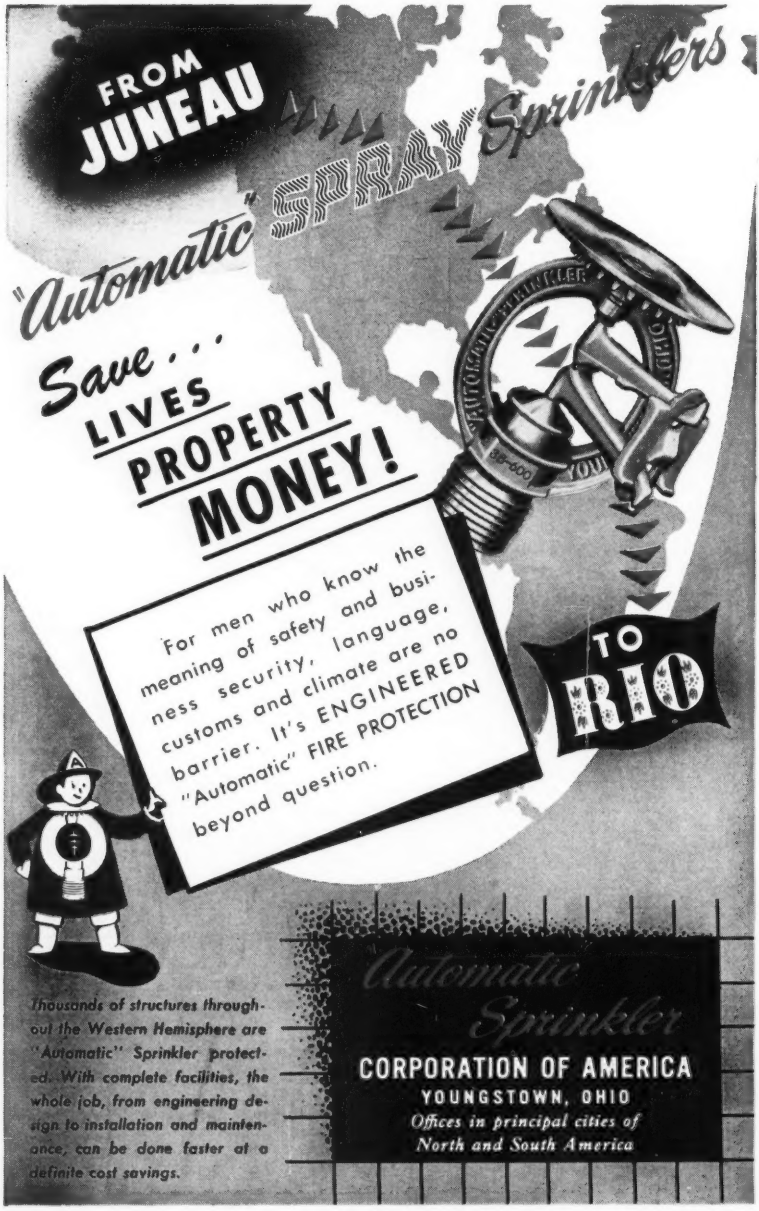
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For men who know the meaning of safety and business security, language, customs and climate are no barrier. It's ENGINEERED "Automatic" FIRE PROTECTION beyond question.
Thousands of structures throughout the Western Hemisphere are "Automatic" Sprinkler protected. With complete facilities, the whole job, from engineering design to installation and maintenance, can be done faster at a definite cost savings.
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Don't Overlook the Connecting Link

The connecting link between the private fire alarm system or sprinkler system and City Fire Department is the Master Box.

Your fire losses are beyond the curb line. And you aren't getting 100% value from your alarm system unless your city circuits are interconnected through the Master Box to industrial plants, schools and public buildings.

Protect yourself and your citizens *all the way*. Close up the gap. Remember, you depend on industry — it's up to you to protect it.

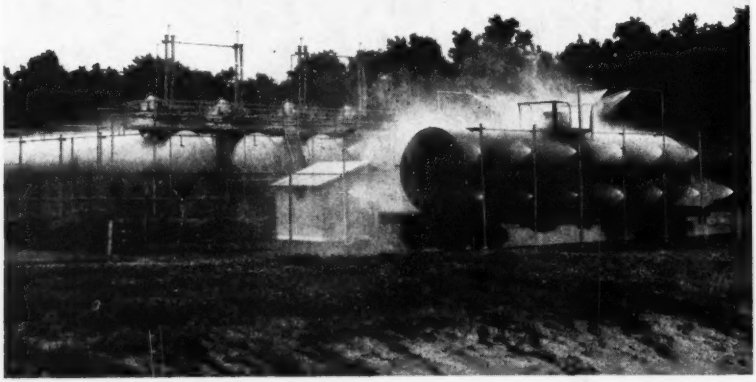
GAMEWELL

THE GAMEWELL COMPANY, Chestnut St., Newton Upper Falls 64, Mass.

In Canada: Northern Electric Co., Ltd., Belleville, Ontario

When fire threatens...

Grinnell ProtectoSpray® drenches LPG tanks



When fire threatens LPG storage, you need plenty of water spray and vapor, fast and in the right places. That is why more owners of LPG bulk storage plants are turning to Grinnell for fire-protection engineering. Grinnell Automatic Fire Protection Systems are the result of more than three quarters of a century of progressive development. They have proved themselves effective guardians of life and property. It is only natural that they are increasingly specified for protection under the severest hazards.

In an LPG tank installation, any leak brings the chance of fire. To avert possible disaster, several things become immediately necessary:

1. The leak must be located and the leakage stopped. Grinnell ProtectoSpray provides a margin of safety for the personnel doing this work.

2. Heat transfer to the storage tanks must be prevented to avoid build-up of rupturing pressure within the tanks. Properly engineered fixed water spray protection provides effective cooling of tanks to prevent pressure build-up.

3. Positive air turbulence should be provided to hasten dilution of escaped gas to make the mixture too lean to burn. Water spray, without dependence upon wind to assist it, provides sustained air movement which hastens the dilution of escaped LPG.

4. Additional inert vapor should be provided to speed the dilution of escaped LPG. Water spray is an abundant source of such inert vapor, the finer droplets vaporizing to produce inert water vapor.

5. If escaped gases ignite, the wide and evenly distributed pattern of fine water droplets from Grinnell ProtectoSpray nozzles permits safe, controlled burning of gases.

Get the complete story. Write for a copy of "Water Spray Keeps LPG Storage A Safe Neighbor". Grinnell Company, Inc., 274 West Exchange Street, Providence, Rhode Island.

GRINNELL

PROTECTION AGAINST EVERY FIRE HAZARD